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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Text-Book Deficiencies.

We feel compelled to record a protest at the comparatively minor place still accorded to cast iron by text-book writers on machine design. There may be some excuse for this in older works, but in re-issues of these, and in new works, there is no reason why the author should be not sufficiently familiar with modern developments so as to be able to give a more truthful impression to his readers than is at present the case.

In a recent and quite authoritative book, issued by first-class publishers, and one which will probably be used by large numbers of students, a table is given of the strengths of ferrous metals. Two cast irons are tabulated, and one is given as having a tensile strength of 7 tons per sq. in., with Brinell hardness 149; the other is stated to be hard cast iron, and is given a Brinell hardness of 172, without any tensile figure. A further table of compositions is given immediately below, and the two cast irons referred to in this table can have no possible relationship to the strength recorded in the first table.

If better and more complete information were not available we should have no possible excuse for making such a protest, but foundry literature of the last ten years in our own publication and those of the Institute of British Foundrymen, and the British Cast Iron Research Association contains ample evidence of modern developments. We think it is in the highest interests of British industry that designers should have access to this information, and it is particularly important that it should be impressed on the student. Through no channel can he be approached so easily than that offered by the standard text-book.

Another very striking feature of even new books of this type is the scarcity of information on the actual design of cast-iron parts. We are aware that most designs have evolved by a process of slow change and experience rather than by mathematical design, but we think, with the information available mentioned above, much more could be done in this direction; in fact the development of an adequate science of design is largely dependent upon the proper absorption and application of the information which has been furnished in the last ten years by foundrymen and metallurgists.

Implied Warranty and the Sale of Castings.

A case of profound interest to the foundry industry has recently been heard before Mr. Justice Roche in the King's Bench Division, in which Cammell Laird & Company, Limited, claimed damages against the Manganese Brass & Bronze Company for alleged breach of contract in connection with the supply of a propeller casting. This case may go down in history as the case of the "singing" propeller, as it was said to emit an exceptional and unusual noise at certain speeds. Judgment was given in favour of the plaintiffs, but a stay of execution was granted to enable the defendants to consider the question of appeal. The interest for the foundry industry centres around the fact that a perfectly good casting had been supplied, but the Judge thought that when the plaintiffs placed the order with the defendants there was an implied warranty that it would fulfil all conditions of suitability for the operation it was destined to fulfil. One can readily imagine all the consequential damages which can be brought into consideration through the failure of any casting or machine part, and it behoves all founders to consider what implied warranty their castings carry. As this implied warranty may exceed out of all reasonable proportions the value of the order received, great attention should be paid to the conditions governing the acceptance of any order. It is the established custom of the trade that the liability of the founder is limited to the replacement free of charge for any casting proved to the satisfaction of both parties to be defective. Foundries have invariably refused to pay any expenses caused by subsequent work put upon a casting by way of machining and fitting. This is logical, reasonable and equitable, as otherwise the foundry would be caused to pay charges over which it had not the slightest control. There is an implied warranty in law that consequential damages, being indeterminate, are never allowed, except in the case of infringement of Patents; yet there have been in recent times cases where foundries seem to have been made liable for damages consequent upon the sale of a casting. We cannot urge our readers too strongly to examine carefully their Conditions of Sale in order that their implied warranties are kept within fair and equitable proportions.

XUM

Cast-Iron Plugs for Ingot Moulds.

By ROBERT JONES.

The accompanying line drawings show, in plan and elevation, two types of cast-iron bottom plugs used in the process of casting steel ingots in cast-iron moulds, and also the method adopted in moulding and casting.

Fig. 1 shows in detail the plugs referred to, and their position in the cast-iron moulds;

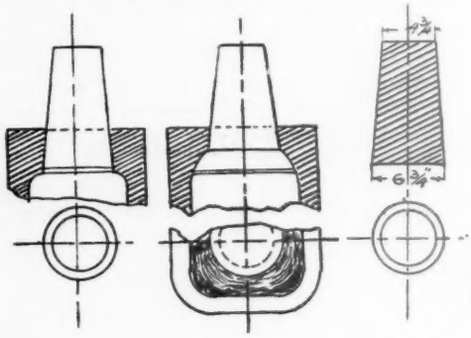

FIG. 1.

FIG. 4.

further details of these can be obtained by referring to page 105 of the FOUNDRY TRADE JOURNAL of February 11, 1932.

The wrought-iron lugs referred to are shown in Fig. 3 to a scale of half size.

The recessed top face at (*e*) on bracket (*a*) is now filled with sand, levelled off and covered with a coat of parting sand in the usual way.

Wood or metal patterns, Fig. 4, are now placed in their respective positions on this face,

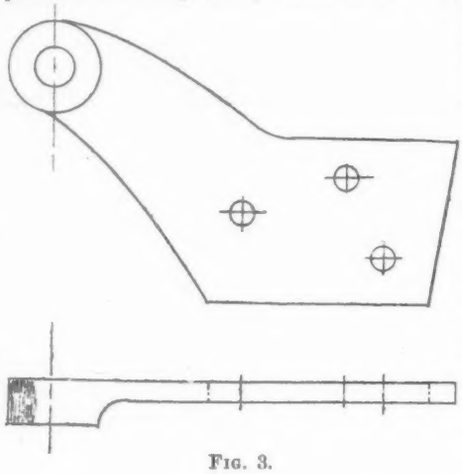

FIG. 3.

and boxes (*b*) rolled over to the position shown at (*f*) and sand rammed around the patterns. After this a sprinkling of parting sand is thrown

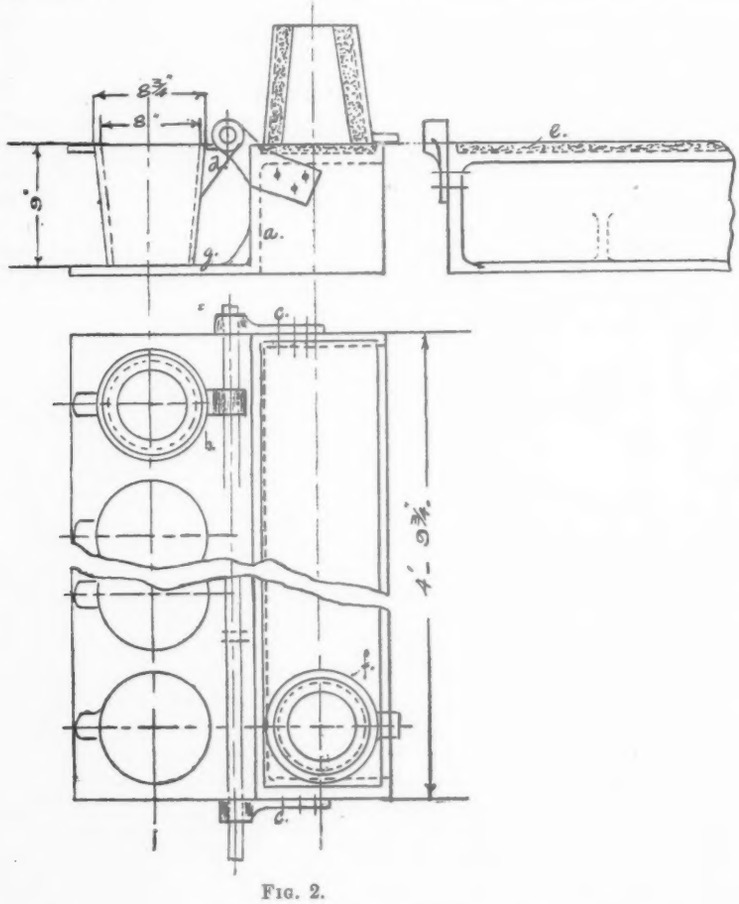

FIG. 2.

The cast-iron bracket (*a*) in Fig. 2 is fixed permanently in a convenient position for casting on the foundry floor. The cast-iron moulding boxes, six in number, are next placed in position as shown at (*b*) in Fig. 2, and the $\frac{3}{4}$-in. iron rod passed through wrought-iron lugs (*cc*), previously bolted in position at each end of casting (*a*). This rod engages lugs (*d*) of each box. over the face of casting (*a*) at (*g*) and the boxes are rolled back on to this face and the patterns withdrawn. The boxes are again rolled back to their position on face (*e*) and are now ready to receive the metal.

A large number of these castings have been made by this method and have given entire satisfaction to all concerned.

Random Shots.

A coincidence is not, as a schoolboy has defined it, one of those places where half-crowns are forged. Nor has the word "coincide" any connection with Jewish snobbery. "Marksman" can give you a very good example of a coincidence. Whenever he has need to consult Miss Nellie Snookers on a matter of some urgency (and Miss Snookers' headquarters are at Eastbourne), the weather, he has noticed, is invariably very warm and sunny. Eastbourne is a particularly pleasant spot in the summer time. . . . It's a theory of "Marksman" that one can think more clearly at the seaside than in the metropolis—in July. Ozone and vita-rays are probably the cause of this.

* * *

(The name of Snookers, by the way, always reminds "Marksman" of the game called snooker, not totally unconnected with pontoon, which reminds him of the asses' bridge, which again reminds him of Euclid's famous theorem; Euclid was a great guy for making things coincide, bringing us back to the point we started from. That's what happens to people who are lost, either for lack of a compass or an idea . . .)

* * *

The sight of the "Show Boat" moored in mid-Thames makes "Marksman" come over all Venetian-like. There is some excuse for him: a great-aunt of his once spent a week in Venice, sailed down the Grand Canal in a gondola, drinking it all in—figuratively speaking, of course. Heigh ho! a romantic family. Have you ever sailed up the Thames in one of those little pleasure steamers? (That, let it be said, is what the owners call them.) "Marksman" never had until one afternoon last month. And whom do you think he saw, boarding the "Royal Sovereign" for Hampton Court? The London representative of a firm of foundry suppliers, plus wife plus infant. "Marksman" has hopes that the "snap" he took of them will secure a prize for him in the "Happy Smiles" competition organised by the "Daily Dash." (Genuine amateur efforts only.)

* * *

FOR THE VERY YOUNG.

La maman de Toto l'envoie acheter une demi-douzaine d'œufs.

"Combien vos œufs?" demande l'enfant au marchand, en pénétrant dans la boutique.

"Vingt sous les œufs frais; dix sous ceux qui sont légèrement cassés."

"Cassez m'en six, je vous prie," dit Toto.

* * *

And then there is this illustration of the subtle workings of the feminine mind.

Doctor: "I advise you, madam, to take frequent baths, get plenty of fresh air, and dress in very light clothes."

Patient's patient husband (an hour later): And what did the doctor have to say, my dear?"

The wife: "He said I ought to go to Palm Beach, and then spend a few weeks in the mountains; also that I ought to buy some cool light gowns at once."

* * *

An Aberdeen gentleman, spending a motoring holiday in England, sent home a telegram to his wife: "Bruises Hurt Erased Afford Analyses Hurt Too Injections Dead." This, "Marksman" is given to understand, is decipherable. He hasn't been able to unravel the thing himself, but the prize offered for the first correct solution is a conducted tour of the Wigan non-ferrous foundries on August Bank-Holiday Monday. Please don't send in your solutions before next Tuesday. At the moment "Marksman" is extremely business, has taken advantage of price levels to have his roof covered with copper sheeting.

MARKSMAN.

A Résumé of the Work of the Malleable Iron Sub-Committee of the Institute of British Foundrymen.

(*Concluded from page 33.*)

Machining of Test-Bars.

During the preliminary discussions on the work to be undertaken in connection with the correlation of strength and microstructure, it was pointed out that nearly all the published data, researches and results of investigations on malleable are based on test-bars tested in the as-cast form. That is, no metal has been removed from the surface of the bar. This is a result of two factors, first, the generally-accepted but erroneous theory that the main strength of all malleable lies in the skin (after annealing), and, secondly, the fact that it has only recently become possible to machine white-iron test-bars (before annealing) economically. The results given are frequently affected by moulding defects such as slight variations in size, roughness of surface or pock marks, cross-joints, etc., and it was decided to make a series of experiments to ascertain the desirability, or otherwise, of machining the test bars *before* annealing. Much work has already been published on the effects of machining *after* annealing, particularly in the case of black-heart.[10] Members of the Sub-Committee have also investigated this privately.

Test-bars were cast to the following sizes:—

Series A.—Tested as-cast at 0.564 in. dia. (B.E.S.A. Specification).

Series B.—Cast $\frac{1}{16}$ in. oversize and machined to 0.564 in. dia. *before* annealing.

Series C.—Cast $\frac{1}{8}$ in. oversize and machined to 0.564 in. dia. *before* annealing.

Series D.—Cast $\frac{1}{8}$ in. oversize and machined to 0.564 in. dia. *after* annealing.

The work was simultaneously carried out in five different foundries and the results are given in Table I. Foundries 1 and 2 are working on black-heart material and Foundries 3, 4 and 5 on white-heart.

The results point to the following conclusions:—

(1) The machining of test-bars *after* annealing is detrimental in the case of white-heart, but has little effect in the case of black-heart. This is in agreement with results obtained by previous workers.

(2) The results of Series B and C tend to show more uniformity than Series A, particularly for the elongation figures.

(3) The elongation results on Series C are somewhat lower than Series B. Probably due to insufficient feeding of the larger bar, or to the increased grain size.

(4) The advantage of "machined before annealed" bars is only slight, and does not warrant the extra expense of machining for general tests.

It is, however, agreed that for accurate research investigation, machining of cast-bars to remove surface imperfections and to obtain correct-sized bars is an advantage, and that such machining has no effect on the mechanism of the subsequent annealing process.

These results, however, form a basis for arguments on different sized bars being used. It will be noted that the results from different foundries vary considerably. This variation is dependent upon the annealing conditions of time and temperature. In each case the process of annealing has been controlled to give good castings, and as the size of work has varied considerably from one foundry to another, the test-bars being of constant size show widely different results. The test-bars obtained from the foundry producing light-sectioned castings are somewhat under-annealed, giving low elongation figures, whilst the bars annealed by the foundry producing heavy-sectioned castings are well-annealed, giving much higher elongation results.

In each case, however, the work annealed together with the test-bars was quite satisfactory, and would probably have given uniform results if a satisfactory method of cutting test-bars from actual castings was possible.

These results show that the present single-sized test-bar with standard requirements is not satisfactory. Discussion on this showed the advantage of a microscopic examination being taken in conjunction with mechanical tests and also that the points raised in the introduction are mainly governed by the microstructure. It was, therefore, decided no immediate further work should be undertaken on the mechanical testing of malleable unless a request be put forward either from the manufacturers, buyers or other bodies, in which case the results and discussions already carried out would be available, but that the immediate future work of the Sub-Committee should be a full microscopical investigation of various types of malleable with a view to correlating the microstructure with the mechanical properties.

On the completion of the above work, the Sub-Committee was very gratified to learn that, as a direct result of the research, one very prominent malleable manufacturer connected with the Committee and the Industry of British Foundrymen was carrying out researches, using test-bars machined before annealing.

Microscopical Examination, Specification and Correlation with Mechanical Properties.

It has not been possible to bring this important section of the work to completion owing to the large number of preliminary problems which arise. But the following notes will show how each of these questions has been overcome and the ground cleared for a full investigation. (It is necessary to add that the majority of this preliminary work was carried out on white-heart.)

The inclusion in any recommended specification of a test or tests which will tend to make that specification more universally applicable (and adopted) must be considered. The works metallurgist not only in the malleable foundry, but also in the steel, grey-iron and non-ferrous foundries, is daily using the microscope more and more to control the product under his care.

o 2

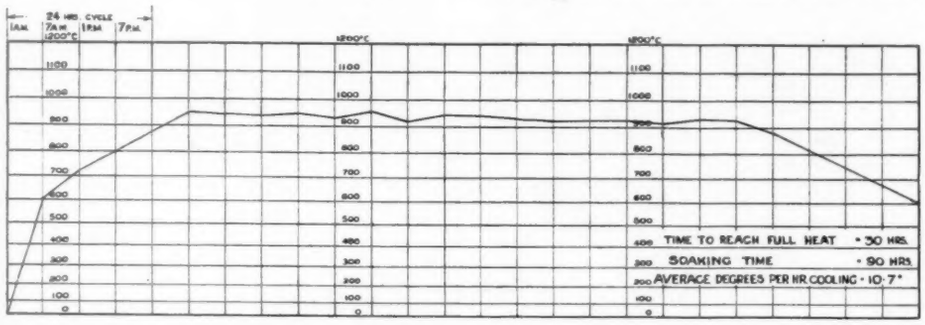

FIG. 9.—ANNEALING CYCLE USED FOR EXPERIMENTS.

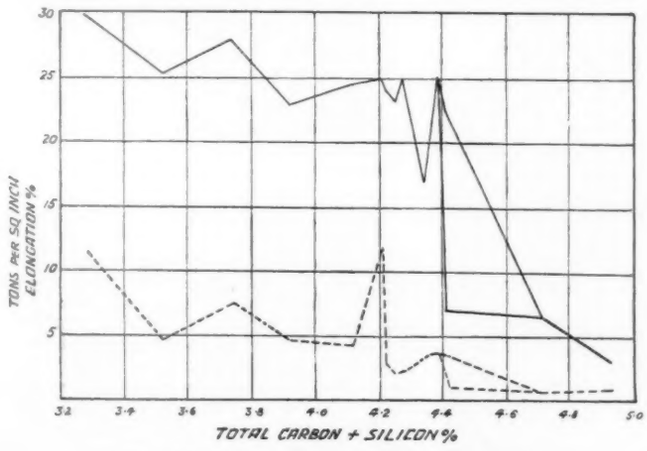

FIG. 10.—ELONGATION AND STRENGTH PLOTTED AGAINST SUMMATION OF T.C. + SI.

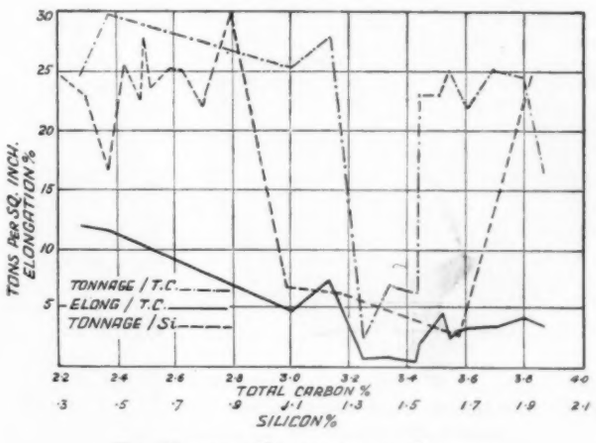

FIG. 11 SHOWS ELONGATION AND STRENGTH AGAINST T.C. + SI.

Samples for microscopic examination can be quickly prepared and may be taken from any test-piece or casting to suit the requirements of the inspection. The necessary equipment for a simple examination is comparatively cheap, requiring very small space and no site preparation, and the upkeep cost is negligible.

It was therefore considered desirable that experimental work should be undertaken to show the relationship between microstructure and other properties. As shown above, the British Standard Malleable Specification stresses more particularly the mechanical tests, this, no doubt,

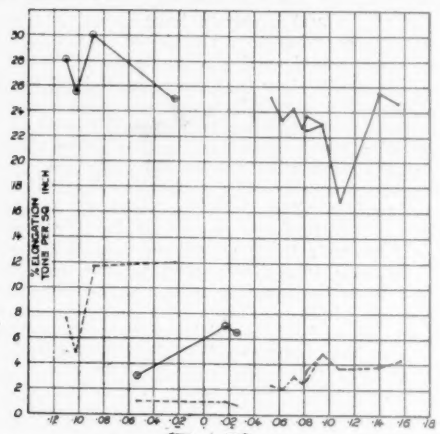

FIG. 12.—TENSILE AND ELONGATION PLOTTED AGAINST EXCESS SULPHUR OVER MANGANESE.

being to meet the requirements of the engineers who are in the majority in buying to specification. This being so, the desirability of expressing any new test in terms of the present generally-accepted test is apparent. The correlation of mechanical strength with the microstructure therefore formed the first work of the Sub-Committee in this section.

Collection and Preparation of Test-Bars.

The necessary differences in mechanical strength required for comparison can be produced in two main ways. Firstly, by using a number of test-bars of one standard composition and subjecting them to different conditions of time and temperature in the annealing process.

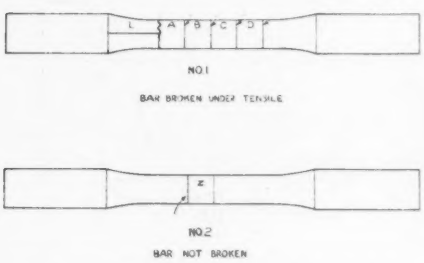

FIG. 13.—SHOWING POSITIONS USED FOR TAKING SPECIMENS.

Secondly, by using bars of different chemical composition and annealing them under the same conditions.

It was decided to use the second method, as the required conditions are more easily produced in the foundry without interfering with the works routine. The test-bars were obtained by admixture to a normal malleable analysis, and, also, by asking malleable-iron manufacturers, to supply bars in their standard analysis, as it is well known that each manufacturer uses a different composition of iron and adjusts the annealing conditions to suit each particular analysis.

Thirty malleable manufacturers were asked to supply test-bars and the Sub-Committee was encouraged by the response to this request, many of the firms being particularly interested in the work undertaken and sending test-bars for examination. Three test-bars to the B.E.S.A. Specification dimensions and of the same chemical composition were prepared for each series. Although previous work had shown the advisability of machining "as-cast" oversized test-bars down to the specification dimensions, it was decided to carry out the tests on "as-cast" bars, so obviating the necessity of each manufacturer preparing special patterns until the methods of preparation of test-bars, here suggested, had been available for discussion, and possibly universally recommended.

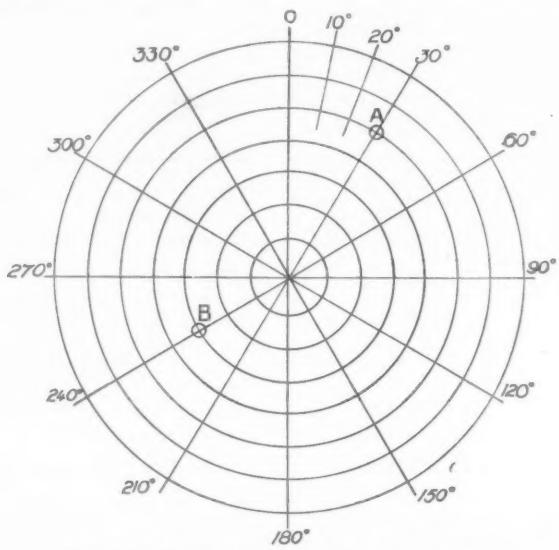

FIG. 14.—METHOD ADVOCATED FOR ESTABLISHING POSITION. FIVE TIMES FULL SIZE.

Gating and Feeding Test-Bars.

Examination of the test-bars as received shows surface faults, while many were cross-jointed and not symmetrical, and showed the widely-different methods of the makers in gating and feeding the bars. The various methods used are illustrated in Figs. 4 to 8. Providing the bars are perfectly sound any method can be used, but Fig. 4 is to be condemned, as running

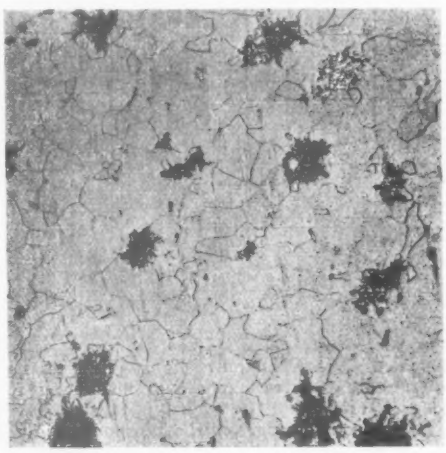

FIG. 15.—NITRIC ACID. × 100.

about the centre means subsequent treatment at the part of the bar where failure results under test. When the method shown in Fig. 5 is used, there is always the danger of surface imperfection and cold laps between the gauge lengths, caused by the meeting of the two streams of metal. Bars cast as in Fig. 6 are liable to show shrinkage at the change in diameter away from the feeder. Feeding at each end and flowing the metal through as shown in Fig. 7 gives sound bars, as does the method of running up-hill as shown in Fig. 8. The two last-named methods or a combination of the two are recommended.

Annealing Conditions.

Each series of bars was given an identification number, turnings were taken for analysis, and then the annealing carried out. The bars were packed in a mixture of used hematite ore to which 8 per cent. of new ore of the following analysis had been added:—

Analysis of Annealing Ore.

	Per Cent.
Ferric oxide, Fe_2O_3	79.50
Ferrous oxide, FeO	4.89
Silica, SiO_2	10.71
Alumina, Al_2O_3	Trace.
Lime, CaO	1.50
Magnesia, MgO	0.60
Manganese oxide, MnO	0.030
Phosphoric acid, P_2O_5	0.019
Sulphur	0.003
Loss on ignition	2.90
Moisture	1.0
Total iron	59.20

The packed box was placed into the oven and subjected to the annealing cycle shown in Fig. 9. The packing medium employed and the time and temperature of the anneal is generally as used for the white-heart process of malleable production, but the maximum temperature and the period at maximum temperature is somewhat lower than that usually attained in the industrial production of the majority of white-heart castings. These conditions were considered desirable, as they would tend to under-anneal the specimens, so producing greater variations in the results and allowing the mechanism of annealing to be better studied than if the bars had been fully or over-annealed.

Correlation of Strength, etc., with Composition.

After annealing the bars were tested mechanically, the results together with the analysis being shown in Table II. The consideration of the analyses show that the samples can be divided into three groups. Lab. Nos. 6,241, 6,242 and 6,262 show free graphite in the "as-cast" condition, and can be excluded from the general group, although they may be of value for very thin castings of a lower grade, and would probably only require a very short anneal.

Lab. Nos. 6,298, 6,300 and 6,302 are of black-heart composition, and should not be classed with the remaining main group of white-heart

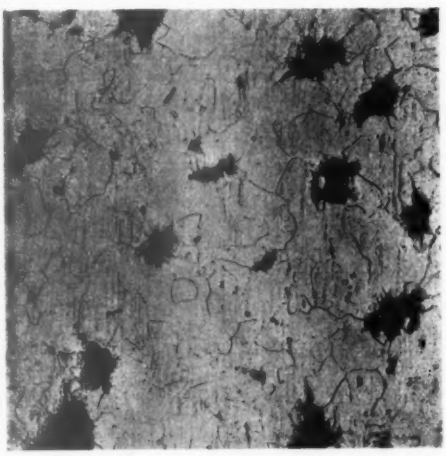

FIG. 16 SHOWS THE SAME FIELD OF A BLACK-HEART SPECIMEN AS FIG. 15, AND ILLUSTRATES THE DIFFERENCE OBTAINED WITH DIFFERENT ETCHING MEDIA. PICRIC ACID. × 100.

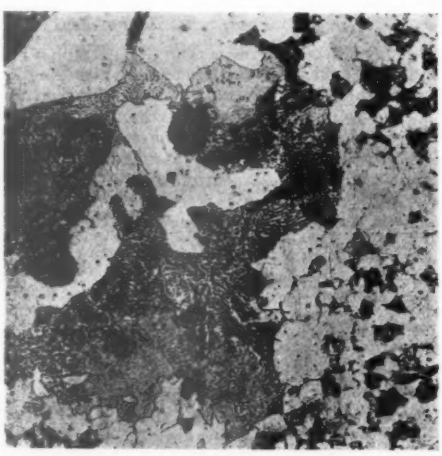

FIG. 17.—NITRIC ACID. × 100.

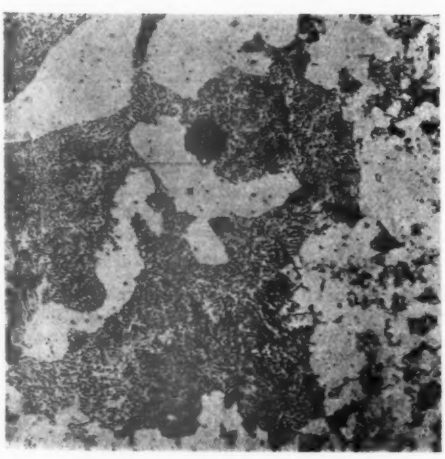

FIG. 18 SHOWS THE EFFECT OF ETCHING WITH A DIFFERENT MEDIUM FROM FIG. 17, ON A WHITE-HEART SPECIMEN. PICRIC ACID. × 100.

specimens. It was decided to continue the work on these eleven series of white-heart test-bars.

Fig. 10 shows the elongation and strength plotted against the mean value of T.C. plus Si in each set of bars, and Fig. 11 the strength against T.C. and against Si, and the elongation against T.C., each point representing the mean value of each set. These curves illustrate the very involved relationship resulting from the causes already mentioned.

In addition to the examination of T.C. and Si and T.C. plus Si, the ratio of Mn and S has been studied. The tensile strengths and elongations are plotted in Fig. 12 against the excess of S over that required to form Mn S. It will be seen that in plotting all the points have not been connected. The lowest figures for tensile strength and for elongation (three sets) are from test-bars which contained considerable amounts of primary graphite and are not commercial products. The other test-bars containing no excess of S are black-heart or bastard black-heart, and the points for these have not been connected to the others. Looking at the graphs to the right of the figure, *i.e.*, the true white-heart malleable, it will be seen that there is no relation apparent between tensile strength and the Mn-S ratio. The results here are obscured by the very variable T.C. and Si contents. This latter variation has, however, not prevented a definite increase in elongation being apparent with increasing excess of S. This accords with the work of Taylor.[11]

FIG. 19.—EDGE OF SECTION TOWARDS CENTRE. × 50. ETCHED 5 PER CENT. NITRIC ACID.

FIG. 20.—EDGE OF SECTION TOWARDS CENTRE. × 50. ETCHED 5 PER CENT. NITRIC ACID.

Microsopic Examination.

Distortion.

The micro-specimens for examination must not be cut from the bar in a position where the structure would be affected by any distortion taking place during the tensile pull. To examine the extent of any such distortion, the following experiments were carried out:—Six bars were cast of the same composition and annealed under the same conditions. Three were then pulled under tensile, the others not being tested. Micro-specimens, L, A, B, C, D and Z were cut from the bars in the position as shown on Fig. 13, the specimens being prepared and examined on the surface indicated by the arrow. In the case of the longitudinal sample, indications of distortion were noticeable close to the fracture, but in all the cross-sectional samples, no distortion of the structure could be seen. It was therefore decided that if a micro-specimen be prepared ½ in. away from the fracture, no distortion from a direct tensile pull will be noticeable.

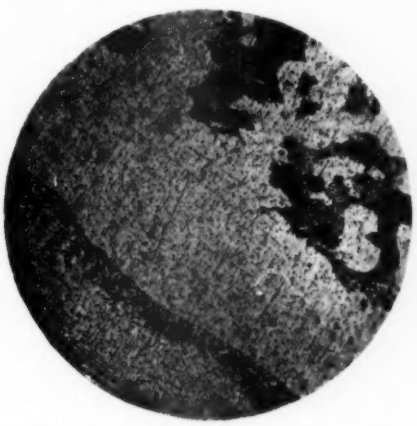

FIG. 21.—EDGE OF SECTION TOWARDS CENTRE. × 50. ETCHED 5 PER CENT. NITRIC ACID.

FIG. 22.—CENTRE OF SECTION TOWARDS EDGE. × 50. ETCHED 5 PER CENT. NITRIC ACID.

This method of selecting the specimens was standardised for the examination of the bars, but, of course, only applies to white-heart malleable. During the carrying out of the above experimental work, it was noticed that each member of the Sub-Committee used different methods of etching the specimens and different magnifications for examination. So that the work of each investigator would be more easily comparable, the following standard methods of etching and examination were agreed upon and are recommended.

Etching.

When the microscopical work was projected it was quickly realised that there was no agreed opinion upon the most suitable etching reagent. It was found that in general picric acid or nitric acid were used. Available literature[12] was studied, and it was found that the diversity of opinion was general. Figs. 15 and 16 show the

same field of a black-heart malleable, etched by nitric in the one case and picric in the other. It will be observed that the grain boundaries are rough appearance due to cold working during polishing of the very soft ferrite. Figs. 17 and 18 show the effect of the two reagents on the

Table I.—*Properties of Malleable C.I. Test-Pieces in the As-Cast and Machined Conditions.*

Series.	A.		B.		C.		D.	
Bar No.	Tons per sq. in.	Elong. on 2 in.	Tons per sq. in.	Elong. on 2 in.	Tons per sq. in.	Elong. on 2 in.	Tons per sq. in.	Elong. on 2 in.
				No. 1	Foundry.			
1	25.20	15.0	25.28	16.0	No	Test.	24.74	15.0
2	25.00	15.0	24.62	14.5	,,	,,	24.18	16.0
3	24.86	14.0	25.10	15.5	,,	,,	24.02	14.0
				No. 2	Foundry.			
1	25.92	14.0	26.80	16.0	26.40	17.0	24.84	14.0
2	26.64	16.0	26.08	18.0	23.84	14.0	22.40	18.0
3	24.56	15.0	25.32	15.0	24.00	13.0	20.2	9.0
				No. 3	Foundry.			
1	31.20	6.0	32.15	4.5	27.75	3.0	35.28	2.5
2	28.36	3.5	29.72	4.5	26.84	3.0	34.24	2.0
3	31.10	4.0	30.14	4.5	26.85	3.0	33.20	2.5
				No. 4	Foundry.			
1	27.10	7.0	26.04	8.0	26.10	7.0	23.20	6.0
2	26.85	6.0	25.20	8.5	27.02	6.5	25.06	5.5
3	28.36	5.5	25.92	8.5	26.54	7.0	24.52	5.0
				No. 5	Foundry.			
1	22.22	5.0	20.40	5.0	18.10	4.5	22.40	3.0
2	21.59	5.5	19.32	5.0	19.20	4.5	22.44	2.0
3	22.29	4.5	19.44	5.0	17.44	4.0	23.36	3.0

Table II.—*Correlation of Composition and Mechanical Strength.*

Chemical Analysis.						Mechanical Strength.				Remarks.
Lab. No.	T.C.	C.C.	Si.	Mn.	S.	P.	Y.P.	B.	E.	
							Tons per sq. in.	M.S. tons per sq. in.	Per cent. on 2 in.	
6,240	3.44	3.04	0.81	0.16	0.154	0.25	17.0	17.0	1.5	
							12.82	24.54	2.5	
							20.98	25.05	2.0	
6,241	3.32	1.49	1.09	0.20	0.132	0.44	4.53	4.53	1.0	
							9.12	9.12	1.0	
6,242	3.25	1.34	1.68	0.23	0.078	0.85	4.17	4.17	1.0	
							1.82	1.82	1.0	
							1.98	1.98	0.5	
6,261	3.55	3.55	0.73	0.18	0.157	0.20	20.92	25.71	2.0	
							21.56	23.90	1.75	
							17.65	25.83	3.0	
6,262	3.43	1.82	1.28	0.17	0.123	0.48	5.12	6.00	0.5	
							4.94	6.36	0.5	
							6.62	6.62	0.75	
6,286	3.45	3.45	0.62	0.14	0.163	0.063	17.80	21.59	2.0	
							19.61	25.36	3.0	
							17.08	24.20	3.5	
6,290	3.42	3.42	0.59	0.16	0.170	0.059	18.14	22.30	2.5	
							18.46	23.54	2.5	
							16.80	22.00	2.5	
6,297	3.70	3.70	0.69	0.15	0.226	0.053	17.04	24.04	3.0	Run side of each end.
							16.13	26.89	4.0	
							17.04	27.27	4.0	
6,298	2.28	2.28	1.93	0.09	0.028	0.069	18.58	24.90	9.0	
							18.56	25.18	13.0	
							19.06	24.82	14.0	
6,299	3.52	3.52	0.40	0.13	0.169	0.080	16.1	23.81	5.0	Run in middle of bar.
							15.39	23.81	5.0	
							15.55	21.65	4.0	
6,300	3.14	3.14	0.60	0.31	0.066	0.027	16.14	28.57	7.5	
							15.44	27.72	7.0	
							19.69	28.18	8.0	
6,301	3.61	3.61	0.80	0.21	0.202	0.058	17.47	20.44	2.5	Run side of each end.
							18.21	22.30	4.0	
							16.91	23.86	4.0	
6,302	2.38	2.38	0.90	0.27	0.052	0.082	17.35	30.92	12.5	
							15.71	28.43	11.5	
							16.96	30.56	11.0	
6,303	3.80	3.80	0.32	0.08	0.201	0.068	16.09	23.67	4.0	Run in centre.
							15.15	25.30	4.0	
							15.61	25.09	5.0	
6,304	2.99	2.99	0.53	0.25	0.131	0.060	17.06	27.21	5.0	Run at one end.
							16.74	26.55	5.0	
							18.49	22.63	4.5	
6,305	3.87	3.87	0.48	0.14	0.189	0.049	16.70	20.69	4.0	
							12.82	12.82	2.5	
							16.39	16.39	4.0	
6,310	3.57	3.57	0.65	0.17	0.169	0.018	16.74	26.50	3.0	
							16.21	23.36	3.0	
							16.08	22.89	3.0	

thicker and less uniform in the picric etch. The sulphide globules also have a fictitiously thick boundary. Both reagents have brought out the same field of a white-heart specimen. The nitric acid shows a more contrasting pearlite, otherwise there is little difference. These results, together with consideration of speed of etching and convenience, persuaded the use of an alcoholic 5 per cent. solution of nitric acid.

Magnifications Used for Examination.

As it is desirable that any recommended methods of examination should, if possible, agree with those recommended by other associations, it was decided to adopt the B.C.I.R.A. standard magnifications of 1, 25, 50, 100, 250, 500 and 1,000.

Fig. 23.—Centre of Section towards Edge. × 50. Etched 5 per cent. Nitric Acid.

It is, however, recommended that these magnifications should be obtained with as high-power objective as practicable rather than by a high-power eyepiece or increasing the tube length of the microscope. For the present work it was decided to use a magnification of ×50 for visual work and photographic records with higher powers if amplification of any part of a specimen was considered necessary.

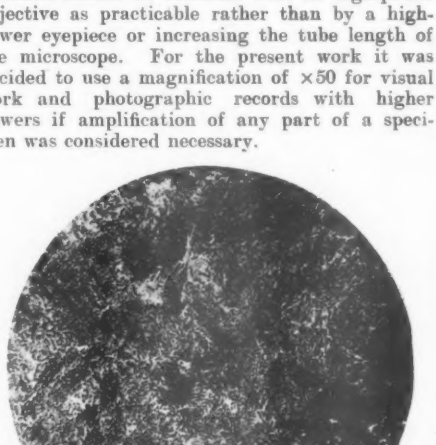

Fig. 24.—Centre of Section towards Edge. × 50. Etched 5 per cent. Nitric Acid.

Verbal Description of Microstructures.

When embarking on the microstructure work it was quickly realised that the taking of photomicrographs would have to be dispensed with as far as possible. This was on account of expense, the very large number of specimens to be examined and time involved. It was, therefore, resolved to see what could be done by means of visual examination and written reports. It soon became apparent that there was considerable difficulty in describing microstructures in such terms that others could obtain a true picture of what was meant. The question was raised, "Can descriptions of microstructures be standardised?" Now it is a fact that works metallographists frequently commit to writing their descriptions of visual microscopical observations, and that at any time they refer to these notes

they are able to obtain a true mental picture of what they previously saw. It is obvious that they adopt a nomenclature and a style of description which is standardised in their own minds. Why, then, should not it be possible for a number of workers to standardise? The Sub-Committee believe that this can be done, and that, once established, all who make themselves familiar with the standard terms will be able to understand any other's description of microstructure. It should be made clear that what it is proposed to standardise does not mean any alteration of the existing metallographic nomenclature, but rather an extension of it as specially related to the structures encountered in malleable cast irons.

The idea is to apply readily-appreciated terms to describe the general arrangement of the structure. For example, ferrite and pearlite, although present in the same proportions, may exist in a variety of formations which at present cannot be intelligently described; also there are many different appearances of temper carbon. It is not impossible, further, that the free carbon nodules should be counted, and that their average size should be stated.

It is obvious that some system of locating any given area for examination and comparison is necessary, and the following method is recommended (see Fig. 14). A zero mark is stamped on the outer edge of the sample at any point. This marking then formed the datum point from which any area could be located. Placing the zero to the top, the specimen is visually divided as shown in Fig. 14. The periphery being marked clockwise in degrees and the examined surface in concentric circles, each of one mm. and numbered from the outside towards the centre. By this means the location of a point "A" is shown as 30 deg. 2 mm., or point "B" as 240 deg. 4 mm. The mm. lines were also used to indicate the penetration of the different constituents into one another. By definitely determining the measurement of the field of view at any magnification, any distance from the outside can be quickly measured. The method can also be used for any irregular-shaped specimens.

Nomenclature.

Figs. 19 to 21 show micrographs of the edges of three bars, and Figs. 22 to 24 the centres of the same specimens. Study of these reveals that not only do the amounts of the various constituents vary widely, but their shape and formation differ very considerably. The work involved in producing a standard system of adjectives, nouns, etc., to describe these variations is tremendous, and at the moment the Sub-Committee have only considered the possibilities and foreseen the advantages, but they feel that the work is well worth tackling.

No recommendations can yet be made, but the following is the outline of a possible scheme:—Depth of penetration of various constituents in mm.; description of ferrite-band, crystal-size expressed in square mm.'s, size of pearlite islands; description of pearlite-ferrite interpenetration, as fjords, deltas, lanes, etc.; description of cementite, primary, secondary, network, nodular, spheroidal, etc.; description of graphite, as primary, secondary, nodular, spidery, compact, size, number per square mm., etc.; reaction to and speed of etching, shade of colour, etc. It is realised that the above is very sketchy, but it shows the lines upon which the work may proceed.

Examination of Test-Bars and Attempt at Correlation.

The white-heart bars were marked with a series letter, as shown in Table II. The 33 specimens were then circulated to the members for examination. It is not possible at this stage to give any very detailed findings, but the following statement shows some general conclusions:—The microstructures had certain features common to all. The extreme edges of all specimens examined contained oxides and silicates in ferrite mingled with pearlite, the latter being more generally pronounced on the inner side. The depth of this structure was never more than one-fifth of a millimetre.

This was followed in all cases by a band of ferrite of very varying thickness, which merged into a pearlite-ferrite structure and varied in ratio, depth and from coarse to fine. In some cases this progressed into a core structure of pearlite with lakes of ferrite surrounding the temper-carbon nodules. In others, the pearlite-ferrite passed into an all-pearlitic matrix, and again in others into a band of pearlite which merged into a pearlitic matrix with sometimes secondary cementite and in an extreme case with the original white-iron structure. In all the specimens the structures passed progressively one into the other. The temper carbon varied considerably in quantity, size and shape. In all cases the nodules decreased in size towards the edge and eventually disappeared at different places in the different specimens. The count of nodules in the centre varied from 3 to 33 per sq. mm.

The highest elongation results were associated with very wide ferrite rims, with the absence of an all-pearlitic zone, and the presence of the pearlite-ferrite lake-structure in the core. Generally the amount of temper carbon was less too, but the size and shape varied over the whole range from small to large and from spidery to compact.

There was a less defined relation between the tensile strength and the microstructure. In general, narrow ferrite rims, finely-divided pearlite and ferrite, and much pearlite in the core were associated with the highest tensile strengths. Where any "as-cast" white-iron structure persisted, the tensile results were low. A cementitic core is not always associated with high-tensile and low elongation as is commonly supposed. In general, the design of the ferrite—ferrite-pearlite admixture or interpenetration appears to be the controlling factor.

BIBLIOGRAPHY.

1 "Mechanical Properties of Malleable Iron on Various Sized Test-bars." Dr. A. L. Norbury (B.C.I.R.A.), F.T.J., Vol. 45, Nos. 787 and 789, Sept. 17 and Oct. 1, 1931.

2 Stotz. "Die Giesserei," Vol. 17, March, 1930.

3 Remy. "Bulletin de L'Association Technique de Fonderie," October, 1930.

4 Engineering News-Record, Vol. 83, p. 132.

5 Proceedings, I.B.F., Vol. XXI.

6 Proceedings, I.B.F., Vol. XX.

7 Specifications Te 35.92 D and Te 38.92 D.

8 A.F.A. "Symposium on Malleable Iron Castings." W. R. Bean. "Deterioration of Malleable in the Hot-dip Galvanising Process." Transactions, A.I.M.M.E. Vol. LXIX, 1923. "Practical Aspects of White Fracture Malleable." D. P. Forbes. Transactions, A.F.A., Vol. XXVII, p. 397.

9 F. B. Riggan. "Forged and Alloy Malleable Iron for Special Uses." "Iron Age." March 24, 1932.

10 W. R. Bean. Proceedings A.S.T.M. Vol. XIX, Part 2. H. A. Schwartz. Proceedings A.S.T.M. Vol. XX, Part 2. E. Touceda. Transactions, A.F.A., Vol. XXIII.

11 Taylor. Proceedings, I.B.F., Vol. XX.

12 "Metallographer's Handbook of Etching," Berglund A.S.T.M., Proceedings. Vol. XXVII.

Conclusion.

It is felt that but little work has been brought to completion, and that this résumé chiefly contains suggestions of matters which are worthy of attention. The sub-committee has only been in existence a short time; its members live far apart from one another, and already the personnel has suffered changes. The Sub-Committee under these circumstances has taken considerable time to find a common outlook. It is thought that there is some value attached to the work already done, and that the projected investigations are of importance. It is hoped that criticism and suggestions will be forthcoming which will aid the Sub-Committee in its future work.

The Sub-Committee gratefully acknowledges the help of the following firms for supplying test-bars, and for the carrying out of tests in their laboratories:—

Bagshawe & Company, Limited; Fordath Engineering Company, Limited (subscribing firm member); Lake & Elliot, Limited; Ley's Malleable Castings Company, Limited (subscribing firm member); Wm. Hammond & Company (Syston), Limited; and to the following for supplying test-bars:—

John Birch & Sons, Limited; Court Works, Limited; T. Gameson & Sons, Limited; Gosforth Foundry Company, Limited; J. King & Company (Leeds), Limited; H. W. Lindop & Son; Edward Lucas & Son, Limited; Shotton Bros., Limited; also to Mr. F. Hudson, who gave much help in the early stages of the work.

Catalogue Received.

Elevators and Conveyors.—It is of the utmost importance to the foundry industry that it should be as familiar with systems of conveying and materials handling in general as it is with the chemical composition of the castings it produces. We know of no British foundry textbook which is at all helpful in this direction, and thus the 144-page catalogue just to hand from Bagshawe & Company, Limited, Dunstable, should be filed in the technical library rather than amongst the trade literature. The illustrations are of such a clear character that one can see at a glance how they would fit in with one's own individual lay-out, or, again, just what to incorporate when creating a mechanised foundry. We at one time imagined that a catalogue devoted to purely foundry applications would serve a useful purpose; now that we have more or less obtained satisfaction, for we find a complete section of 22 pages devoted to foundry applications, we are not too sure of our ground, and are tending to favour one sectionalised to cover gravity roller, pendulum, apron, screw, platform, belt, bucket elevators, and so on. Our *volte-face* is due to the increased knowledge amongst foundry executives of mechanical handling, which enables them to pick out from other trades applications and ideas germane to their own practice. Naturally, we would include a section showing how combinations of conveyors and elevators go to make complete plants, and, moreover, we should regard this as the chief section of the whole catalogue. The system disclosed in this catalogue is to take the various trades and industries and to show how their handling problems have been solved. This method has the advantage of making a direct appeal to others in those industries to emulate the progress registered by their competitors in this direction.

The most interesting aspect of this publication is the conviction it carries that the issuing firm is so specially experienced that they can be well entrusted to take over four walls and lay out the interior so as to evolve a foundry necessitating minimum of handling commensurate with capital expenditure and proposed production.

There are, to our mind, two features of outstanding merit in this compilation. One is the inclusion of several questionnaires to facilitate intelligent setting out of inquiries, and the other is the decorative border on pages 2 and 3. To name the whole correctly would form a general knowledge test of the highest order. We confess to wasting much time puzzling over the various articles illustrated. We have just one adverse criticism, and that is, the black dotted lines round all the illustrations should have been grey, as they detract somewhat when the illustration occupies the major portion of the page, as, for example, on pages 15 and 37, to choose at random.

To Visit Russia.

Mr. P. Fox-Allin, Associate Editor of THE FOUNDRY TRADE JOURNAL, is leaving in the near future for an extended tour in Russia, with the object of obtaining first-hand information of the recent industrialisation of that country. Readers who would like specific information on any particular phase should communicate with the Editor.

XUM

High-Test Iron.

AMERICAN AND BRITISH CONDITIONS COMPARED.

DISCUSSION AT NEWCASTLE.

Mr. C. H. Kain said that the Paper* was remarkably interesting as showing what immense possibilities there were in the making of high-strength irons. In general, the results and findings quoted were in agreement with his own experience in the production of quality irons, but one or two statements called for comment. The price of £6 1s. 4d. per ton of metal in ladle, given as the cost of a duplex process, was high compared with the practice in this country and must be far in excess of the cost of the cupola metal mentioned in the Paper. In nearly all cases, the silicon content was much higher and the combined carbon lower than would be used for the same conditions in this country. One naturally expected these two features to be associated, but it was difficult to account for the high strength and Brinell hardness in irons having such low combined carbon. Superheating was mentioned as causing refinement of grain. What temperature was meant by superheating? Claims were frequently made to casting temperatures of over 1,500 deg. C. from the cupola.

This figure was at least 50 deg. C. too high, and, where it was registered, the foundry concerned would be well advised to check its pyrometry, especially if the structure of the iron showed flake graphite. Dr. Norbury and the B.C.I.R.A. had shown that superheating definitely produced a ferrite, long, dark, fine-graphite structure which was comparatively weak and soft, but which was readily machinable. It was also his experience that superheating was often associated with the phenomenon known as "inverse chill," particularly when the temperature was over 1,500 deg. C.

In the example given in detail of a cupola producing high-test iron, the charge was said to include 6 to 10 per cent. returned high-test iron scrap. As this type of iron required very heavy feeders, etc., the yield of castings was seldom more than 60 to 65 per cent. Therefore, there must be at least 35 per cent. remelt in each charge unless the scrap was sold. It would be interesting to know how this was dealt with at the plant in question. Finally, a ladle addition of ferro-silicon and ferro-manganese was made. As this addition absorbed heat, was any difficulty experienced with chilling of the metal, incomplete alloying or short-run castings? Would it not be advisable to make use of the exothermic reaction which occurred when CaSi was added to the metal at the spout?

He would like to congratulate Mr. MacPherran on his excellent Paper, and to thank him for collecting and preparing such a mass of valuable data.

Cupola Melted Irons.

MR. F. K. NEATH, B.Sc. (Keighley), said that he proposed to confine his remarks to the cupola-melted irons mentioned in Mr. MacPherran's Paper. Table I confirmed the general experience with low-carbon irons, that the silicon content did not matter very much as long as it was between 1.5 per cent. and 3 per cent. It would appear, however, that whilst high-tensile could be obtained in this way, it was difficult to say beforehand what the tensile would be, *i.e.*, 23 tons or 30 tons per sq. in. This wide variation seemed to indicate that some other variable was at work besides composition and possibly a combination of graphite size and distribution was the factor. The question was, did this variation in tensile indicate some factor which should be more fully understood, as the higher the quality of the material, the more necessary it became to have reliable data upon which to work for designing purposes? According to Mr. MacPherran, the Brinell hardness of a 4-in. section was practically uniform, whereas the tensile strength varied from 22.5 tons per sq. in. in a 1¼-in. dia. bar down to 13.3 tons per sq. in. in a 6-in. section of a casting. Would the same relations hold for metal which gave 30 tons tensile on a test-bar?

Mr. MacPherran's Paper was a valuable addition to the proceedings of the Institute, as foundrymen in this country would now have an authoritative summary of the present position of high quality irons in America. Mr. Kain's remarks regarding temperature measurement at 1,500 deg. C. raised a very pressing problem which still awaited a practical solution.

The Chairman (Mr. C. E. Williams) bringing the discussion to a close, said that he noticed that one of the tests mentioned in the Paper lasted 8,000 hours, which was roughly about eleven months. He thought that this was an extraordinary test. These international Papers had great value in helping the world to settle down because of their usefulness in distributing knowledge. They ought to do all they possibly could to encourage international Papers.

A Survey of Testing Conditions.

MR. J. G. PEARCE, M.Sc., Director, British Cast Iron Research Association, wrote that he had an opportunity two years ago of seeing the production of high-test cast irons in the United States and saw the material made by Mr. MacPherran at the Allis-Chalmers works. The report then prepared was confirmed in practically all points by Mr. MacPherran's description, although considerable progress had evidently been made in the meantime. The results gave cause for congratulation. They pointed to the value of the procedure which the British Cast Iron Research Association calls the inoculation process, which has followed the development of the germ theory during the last few years. It is assumed that the ferro-manganese used by Mr. MacPherran is the 80 per cent. manganese alloy, and the writer would like to know the carbon contents of both this and the ferro-manganese-silicon alloy used as a ladle addition.

It was particularly interesting to notice that Mr. MacPherran's results are obtained in the soft-blast type of cupola which the British Cast Iron Research Association had consistently advocated, particularly for steel-melting, for a number of years.

Mr. MacPherran gave some figures tending to show that similar results are obtained from both British and American standard tests. It is suggested that these figures did not wholly dispose of the problem, as British founders had occasionally been puzzled by the comparatively high American figures. In the standard British specification the 0.875-in. bar was machined to 0.564 in. for tensile and the 1.2-in. bar to 0.798 in. The American standard 1.25-in. bar was machined for tensile to 0.505 in., and for hard irons it had frequently been found that this gave a higher tensile figure than the larger bar. The American bar, moreover, was cast in a dry-sand mould or cores, whereas the British bar was cast usually in green sand. Recent experience had shown that hard irons cast in dry sand had higher strength than similar irons cast in green sand. Soft irons, however, were ameliorated by the slightly chilling effect of the green-sand mould. So far as the transverse test was concerned, a bar tested at 12-in. centres would be slightly stiffer and had a greater breaking load than would be expected by ordinary calculation from the result of the same bar tested at 18-in. centres. In other words, the load on a transverse bar tested at 12-in. centres would be greater than that on the same bar tested at 18-in. centres than was given by the ratio 18 : 12. These differences suggested that in order to see whether the American test gives consistently higher figures than the British test on the same iron, the whole of the details of the specifications of the respective countries required to be followed out, and it is suggested that interested British manufacturers might try this. Altogether Mr. MacPherran's Paper is one on which he can be very cordially congratulated.

* High-Test Cast Iron Developments in the United States, by R. S. MacPherran.

American Society for Testing Materials.

The Thirty-fifth Annual Meeting of the A.S.T.M. was held in Atlantic City during the period June 20 to June 24. Whilst it is but natural that some committee activities would have to be curtailed, there was no evidence in the meeting that such was the case. More than 155 meetings of main and sub-committees were held. Fourteen active sessions were necessary to make room for the ninety Papers and reports presented. In addition, two informal conferences were held at which Papers giving the importance and application of statistical data were presented.

The session on textile materials was a pronounced success and well attended by leaders in the industry. A Symposium on Steel Castings (comprising two sections) brought many of the technical men prominent in the foundry industry to the meeting. The list of items involving the non-ferrous metals field was more extensive than usual and two sessions were needed to permit the presentation and discussion of the Papers.

The final report of the extensive research project on the embrittlement of hot-galvanised structural steel brought out the important fact that brittleness in shapes where the thickness is above ¾ in. was due to punching the rivet or bolt holes. Drilled or reamed holes in heavy sections prevent this dangerous phenomenon. "Galvanised embrittlement" in this or medium-size stock was not found.

Dr. Taylor, head of the Princeton University Chemistry Department, in his presentation of the Seventh Edgar Marburg Lecture on "The Problem of Resistance to Deterioration," outlined the tremendous strides made in the determination of speed of chemical reactions which is a major problem in understanding the causes for deterioration of materials, and stated his conviction that chemists must devote more time to a study of chemical changes which promote deterioration and must investigate and discover inhibitors.

Six Papers and reports on concrete made up the closing session. Valuable data on consistency and volume changes were given and a suggested freezing-and-thawing test was reported. It was announced that the 1933 meeting would be held in Chicago in June and that the Second Exhibit of Testing Apparatus will be held in conjunction therewith. Mr. Cloyd M. Chapman, Consulting Engineer, New York City, was elected president.

Wooden Roll-neck Bearings.—Roll-neck bearings, made of lignum vitæ and known as "millwright" bearings, are being lubricated at many rolling mills by water sprays. The rate of wear and the power losses are lower than bearings lubricated with grease. Lignum-vitæ bearings have served for 13 months without replacement on certain finishing stands of a mill in the Chicago district.—"Steel."

Theory of Moulding and Casting.*

FRENCH EXCHANGE PAPER BREAKS NEW GROUND.

DISCUSSION.

The PRESIDENT pointed to the author's statement, in the last column of the Paper, that "the dynamic effect, in other words, the force with which the stream strikes the plane"—*i.e.*, the plane struck by the molten metal when it passed down the feeder—"is measured by twice the static load multiplied by the sine of the angle of impact. It follows that if B = 90 deg." ("B" is the angle of impact) "the shock is exactly measured by double the static effect . . ." The President found it difficult to understand how the dynamic effect could be measured as a multiple of the static load. The static load, he said, was a definite weight, which was a matter of specific gravity multiplied by mass, but a dynamic effort was a force. Therefore, in some way the dynamic effect must have relationship to the velocity which could be gathered whilst the metal was running down the feeder, and he suggested that a calculated dynamic effect which neglected gravity—he was not speaking of specific gravity—must fail to give a correct idea. In this connection he recalled that many years ago a certain works in Sheffield, which was concerned with the making of railway springs, had had to test the permanent set of springs for a South American railway by dropping a weight on them from a given height. The people at the works had not the means for such a test, but they had a compression machine by means of which they could compress the springs until they were flat, and also beyond the horizontal, and ascertain what permanent deflection occurred. Experts in testing methods in Sheffield had tried to work out a static load which would be the equivalent of the dynamic stress intended to be imposed on the springs by the dynamic test, and had given figures so high that the makers of the springs were appalled, but when the static test was applied to the springs it was found to have only a fraction of the destructive effect which would have been imposed by the dynamic test. Therefore, he asked whether the statement in the Paper to which he had referred was a complete statement of the facts.

MR. J. S. G. PRIMROSE said that, taking the purely mathematical view, he would suggest that, in view of the change of direction of the flow of the metal, passing from the vertical to the horizontal, the velocity effect was very much minimised. The author had mentioned that v should be as small as possible in one case, and in that case it was not the direct velocity, but what might be called the momentum of the moving mass, which was producing the dynamic force. Hence, the author was neglecting v, being small, giving as the pressure the force due to the momentum, which he might be perfectly right in considering to be twice the static.

The PRESIDENT pointed out that they were dealing with something which took place in actuality, and not merely abstract theory; they wanted to know how these things applied to the practice of casting. He quite agreed that Mr. Primrose would be right if he confined himself to an inapplicable abstract case, but that was not what the author of the Paper had set out to do. They could, otherwise, all find such things as had been mentioned by reference to textbooks. One wanted to know the dynamic effect of the momentum of the stream, if it was perpendicular, in a metal which was disintegrating the material it was touching.

(COMMUNICATED.)

Since taking part in the discussion, I find the author states v should be as small as possible when the stream is *rising*. I believe Mr. Primrose considered that to be the presumption under all circumstances. This may explain his and my divergence of view. It remains clear that, unless the author has omitted an intended assumption, the dynamic effect must include v^2 in the great majority of circumstances.

MR. C. E. WILLIAMS (Senior Vice-President) said it was interesting to note from the Paper the difference between the working of the Latin mind and our own. It seemed to him that if the British foundryman had set out to tackle the problem of impact he would have put up a small mould and spring balances at the sides, and would have made an experiment. Mr. Williams also commented upon the value of the close contact established between the Institute and kindred bodies abroad. The trouble throughout the world to-day, he said, was the growth of nationalism since the war, and anything that the Institute could do to further friendship between the nations was to the good. The key to the trouble was the feeling existing between France and Germany. England was the friend of both those countries; experience had shown that if two people who were unfriendly towards each other were friends of a third this joint friendship gave hope for friendship all round.

MR. J. H. COOPER urged that the Paper was of such magnitude that it called for intensive study before one criticised it. Obviously, it contained a certain amount of knowledge which could be applied, not only to foundry practice, but to science, and if the members studied it at leisure they would certainly derive benefit, either directly or indirectly.

MR. E. LONGDEN pointed out that at the moment of the filling of a mould there was a great deal of unknown pressure, due to confined gases, but that had not been referred to and was very important. He protested against the very nature of the Paper. Earlier that morning Mr. J. Smith had urged the need for practical Papers, put forward in a practical way; probably Mr. Smith would be awe-stricken by this Paper, indicating how practical moulding operations could be contemplated in a scientific way. An apprentice or anyone would learn more by spending two or three days in the foundry than by reading the Paper.

Mathematics or Impericism.

MR. F. HUDSON, who said that apparently the Paper was more a mathematical treatise than anything else, referred to the conclusions stated at the end of the Paper, particularly the statement that it was obvious that sand alone, even when dried, could not be expected to withstand the forces and couples which had to be resisted; he asked how that conclusion could be reached, when the average foundryman was not aware of the forces that his sand would stand. One could obtain oil-sand cores which would withstand pressure up to 160 lbs. per sq. in. without reinforcement. To obtain the full value of the Paper, it would appear necessary that the foundryman must take a greater interest in the physical properties of the various sands used and develop an active interest in the routine testing of mould materials.

MR. WESLEY LAMBERT, C.B.E. (Past-President), said he assumed that the pressure of 160 lbs. per sq. in. referred to by Mr. Hudson was a static load—a different thing from a dynamic force. He went on to point out that if molten metal was falling into a mould, and impinging upon a material which crumbles under the force of impact, it would be difficult to arrive at the true dynamic value of the blow occasioned by the falling stream of metal.

The PRESIDENT said the author's conclusion was that sand alone could not be expected to withstand the forces and couples mentioned. One could scarcely regard an oil-sand mould as sand alone.

MR. HUDSON replied that he was not accepting the Paper as literally as all that. He had assumed that the author had intended to imply the materials used by the foundryman.

MR. A. HARLEY (Past-President) supported the view already expressed, that the attempt to discuss the Paper before giving it adequate study might create a false impression, and he urged that members should reserve their judgment in these matters. If those who devoted the necessary study to it could find anything which would advance our knowledge of the pouring of castings in the slightest degree, then the Paper was of value to the Institute.

Where Mathematical Considerations are Essential.

MR. F. W. ROWE, who heartily supported Mr. Harley's remarks, said it seemed that one or two members had passed premature judgment on a Paper which contained quite a large amount of useful and valuable knowledge, and that careful study would yield something of real practical value to a great many of the members. Mathematical calculations of the dynamic stresses set up in the pouring of a casting might not appear, to many people, to be of real practical use, but in his experience he had found it essential at times to abandon for the time being purely hit-and-miss considerations of dynamic stresses, and to get down to basic mathematical calculations. He was interested particularly in the centrifugal casting of metals, and had found that, in order to obtain a true view of that particular branch of founding, it was essential to study it from the mathematical viewpoint before attempting to study the more practical side of the business. It was remarkable that, with different peripheral speeds, different sizes of castings and different methods of pouring, there were enormous variations in the dynamic stresses which could be set up in such a thing as a centrifugal casting. One wondered at times why certain cores or certain moulds would break up under the centrifugal stresses imposed, but when one came to calculate those stresses, one appreciated the enormous differences and the reasons for the seemingly anomalous behaviour of different types of sands and different types of moulds. He suggested that the very novelty of Mr. Pillon's Paper had rather startled a good many people, but that the study of foundry practice from any new angle was bound to yield something of real value.

MR. A. S. WORCESTER suggested that the Paper should be discussed through the medium of correspondence, in fairness to the author, bearing in mind that members had had the Paper in their hands only a short time.

This suggestion was adopted, and the President said that a reasoned reply would be obtained from the author, to whom the criticisms would be submitted.

Alloyed Wrought Iron.—A new development in the manufacture of wrought iron is announced by the Highland Iron & Steel Company of Chicago, an associate of the American Chain Company. This is the production of a wrought iron alloyed with nickel, with copper, with nickel and molybdenum, and with copper and molybdenum. The introduction of alloys in wrought iron opens greater fields of usefulness for this material without changing in any way its fibrous structure, says the statement. At the same time it results in a 25 per cent. increase in the strength of the material in the as-rolled condition. Of these alloys, wrought iron with nickel alone and with nickel and molybdenum have outstanding characteristics, we are told. Both have shown a marked increase in fatigue-resisting properties. Heat-treated nickel and nickel and molybdenum alloyed wrought iron show an increase in strength of 40 to 50 per cent. over ordinary wrought iron.—"Iron Age."

* In the absence of the Author, this Paper by M. J. Pillon was briefly introduced by Mr. V. C. Faulkner (Past-President).

Opening Up New Fields for Cast Iron Utilisation.

HEAT-TREATMENT OF ALLOY IRONS SHOW PROMISE.

Mr. Hurst's Paper on "Hardening Cast Iron"* was well received and expert opinion was in agreement that new fields were now available for exploitation. The discussion was opened by MR. WESLEY LAMBERT, C.B.E. (Past-President), who said that, having been associated for many years with one of the largest hardening and tempering plants in the Kingdom, he could claim to know something of the happenings consequent upon the rapid cooling of large masses, and particularly masses of complex shapes and unequal sections. He asked whether Mr. Hurst had carried his investigations sufficiently far to enable him to say definitely that there was no undue liability, in the case of the heat-treatment of cast iron, to the development of surface-hardening cracks. One very effective test was a drop test, in which either the casting itself was dropped from a height, or a heavy weight was dropped on to the casting. By applying such a test on a casting, after the hardening operation and before tempering it, surface cracks induced by the sudden quenching of the mass are often made evident. Simple forms do not present much trouble. Large castings of intricate shape and unequal sections when heated to a high temperature and cooled rapidly, as happens when heated masses are plunged into oil, do not always respond kindly to such drastic treatment. Skin cracks, which later develop into deeper cracks after the casting has been in service a while, are not an uncommon happening. Distortion, also, is not uncommon. Referring to the tempering of the parts after oil quenching, he remarked that the temperature was given; but what was the method adopted? Were the parts reheated and then allowed to cool out in the air, or was cooling effected by slow cooling in the actual heating chamber?

With regard to the nitrarding process, more particularly to the extent of the dissociation of the ammonia, was the value of 30 per cent. dissociation maintained throughout, or was it boosted up as the absorption of nitrogen by the metal proceeded?

Discussing further the distortion of parts as a result of quenching, Mr. Lambert quoted his experience that the majority of thin-walled castings of complex shape, when quenched from a high temperature, were more or less distorted. Not only were castings found to be distorted when removed from the quenching medium, but even after rough machining, further distortion took place, and it was sometimes advisable to suspend the operation of finishing machining for a lengthy period. He personally had had no experience in the process of heat-treating cast iron, but he would like to ask Mr. Hurst whether, in the case of these heat-treated alloy cast irons, distortion was very noticeable.

Rate of Cooling and Strain.

DR. A. B. EVEREST said that the subject of the heat-treatment of cast iron had been one of great academic interest, but, as Mr. Hurst had shown, it had now reached the stage of becoming of practical importance. Amongst the examples contained in Mr. Hurst's Paper were suggestions, covering a variety of industrial applications in which cast iron, hardened by the various methods dealt with, which would be of great future service in eliminating such persistent troubles as wear.

Reference had been made to the inclusion of various alloying materials, such as chromium, nickel, aluminium, and so on, and he asked what was the precise influence of these metals on the heat-treatment operation. In the heat-treatment of cast iron or steel, two factors were of predominant importance. There were:—(1) The temperature from which the quenching operation was carried out and (2) the rate at which cooling took place. The temperature from which quenching must be effected in order to produce a given degree of hardness was fairly easily determined and attained, but the whole crux of heat-treatment, as applied to cast iron, was the second consideration, namely, the rate of quenching. He stated that the reason why the heat-treatment of ordinary cast iron had not, up to the present, been commercially developed was that the rate at which it had been found necessary to quench in order to attain a good result, was so rapid that the castings could not stand the strain involved in the treatment. In the case of ordinary cast iron a quench in cold water from a temperature of 800 or 900 deg. C. was needed, and, except in the very simplest shapes, ordinary castings would not stand this. The outstanding feature of the present Paper was that, by the use of alloy elements, the rate of quenching could be controlled and modified so that the treatment became applicable to quite complicated and lumpy castings.

It appeared at the moment that nickel was outstanding as the element which, in the case of both cast iron and steel, had a marked effect in slowing up the necessary rate of quenching, and he asked whether Mr. Hurst thought that chromium, in the presence of the high-carbon involved, had a similar effect. In experiments with which he (Dr. Everest) had been associated, it had been evident that if a casting of a given section was heat-treated by quenching in water, then the casting might or might not remain intact. When 2 or 3 per cent. of nickel was present, however, the rate of quenching was so slowed up that a similar hardness result could be obtained by quenching in oil, or even in an air blast. The casting, even if of quite complicated shape, was able successfully to withstand these much milder conditions. Previous experiments had shown that, with 5 per cent. of nickel, the casting was martensitic "as-cast." This result was produced simply because the rate of quenching was so slow that it corresponded to the speed at which the casting cooled in the mould.

Heat-Treatment and Strength of Cast Iron.

A point of outstanding interest was the influence of heat-treatment on the strength of cast iron. Mr. Hurst had shown that an iron which had originally a strength of 25 tons, after quenching and tempering showed a strength of almost 30 tons. In one set of experiments recently carried out it was shown that, if the casting was tempered at temperatures superior to 400 or 450 deg. C., a condition was reached in which the hardness produced by quenching was eliminated and this property was reduced to the original level shown in the "as-cast" condition. It had been found, however, that, on tempering at these higher temperatures, the tensile strength of the iron did not fall in the same degree, and, in one case, an iron as used for heavy cylinders was alloyed with 2 per cent. nickel and 0.5 per cent. chromium and showed "as-cast" a tensile strength of 14 tons. This iron was then hardened and tempered under the normal conditions referred to by Mr. Hurst, and then showed a hardness of about 400 Brinell and a tensile strength of 23 tons.

When tempering was carried out at temperatures approaching 500 deg. C., however, the hardness figure fell back to the original 220 but the tensile strength was maintained at well over 20 tons, showing an ultimate increase in strength of about 50 per cent. If one could subject an ordinary iron to such a relatively simple treatment and increase its strength by 50 per cent., at the same time maintaining a readily-machinable structure, it would appear that this might be of commercial importance in connection with a variety of industrial applications.

A Complicated Heat-Treated Casting.

Castings which have been subjected to heat-treatment have been illustrated by Mr. Hurst, but none of them was quite so complicated as one which had come to his notice. This was a cam about 6 in. in dia. and 1½ in. thick and carried on one side a guide standing out on legs about 3 in. long. The cam was split and the working surface was required to show a hardness of about 400 Brinell. Made up in a composition of iron as indicated above, this cam, after hardening and tempering, showed not the slightest trace of distortion and was in every way satisfactory.

With regard to Table I in the Paper, Dr. Everest asked if there was any significance in the abnormally high total-carbon figures shown. It was possible that the total-carbon content might have a very profound effect upon the manner in which these irons responded to heat-treatment. In each case shown in the Table, the total-carbon content was over 3.7 per cent., and he asked if that effect was intentional and had any direct bearing on the results.

With regard to the response obtained on the heat-treatment of castings which had been subjected to a long anneal, so as to break down the combined carbon, he asked whether, during the heat-treatment operation, conditions were not such that an appreciable amount of the carbon might return to the combined condition before quenching. If this occurred then it would afford a plausible explanation of the remarkable result shown by Mr. Hurst in Table IV.

MR. F. K. NEATH, B.Sc., referring to the tensile-strength figures quoted in the Paper, said he gathered that the bulk of them were calculated from the usual EN ring test, and that they were not the results of true tensile tests as carried out normally. He asked the question because, whilst the bulk of Mr. Hurst's work had been concerned with piston rings and liners, he had shown photographs of large castings, and it would be interesting to know if actual tensile pull tests had been taken on these castings at, say, the centre and the edges. He also asked if heat-treatment affected the graphite size and distribution. The temperatures at which the castings were treated were sufficiently high to cause an alteration due to the absorption of graphite.

Use of Accelerators.

MR. F. W. ROWE, B.Sc., said that the improvement of the wear resistance of cylinder liners was of great technical importance to the automobile industry and to all internal-combustion engine builders, and, as he understood it, the position was rather unsatisfactory. He believed all car owners were getting tired of fitting new pistons; it seemed to be much more necessary to-day than it was 5 or 10 years ago, and the problem was occupying the attention of, and worrying, a good many automobile manufacturers. Mr. Hurst had opened up a very promising field in which something could be done to help the industry.

Discussing the nitrogen-hardening of centrifugally-cast cylinder liners, he asked Mr. Hurst whether, and with what results, he had tried the use of various accelerators, such as aniline or magnesite, etc., to reduce the time necessary for the nitrogen-hardening process, applied to cast iron. Many people were applying the process to steel and were using some form of acceleration to reduce the time necessary to produce the maximum depth of case. A great disadvantage of the nitrogen case-hardening process, as compared with the more usual methods, was the large time-cycle that was involved, and it was

* Presented before Newcastle Conference of the Institute of British Foundrymen.

very useful and profitable to study the effect of accelerators and to be able to reduce the time needed to obtain the maximum depth of case from about 90 hrs. to something under 50 hrs. by their use.

MR. PHILLIP A. RUSSELL, B.Sc. (Leicester), asked what were the foundry properties of the aluminium-chromium alloy. Was it easy to cast, or was it subject to great fluid contraction, or anything of that nature?

Overcoming a Dock Gate Valve Trouble.

MR. F. HUDSON acknowledged that this Paper, and previous Papers submitted by Mr. Hurst, had been already of very great help to him personally. He instanced an experience concerning some valves for Southampton Docks. They had been made of ordinary cast iron, and had lasted exactly three months. The water used there was under high pressure, and contained a quantity of sand, so that a very erosive action had occurred, and the sand and water mixture had cut through the wedge of the valves. Following Mr. Hurst's recommendations in the Paper, it was decided to heat-treat the valves, and also to put in an alternative valve, made of high-nickel cast iron—having a 5 per cent. nickel content—and a martensitic structure. All the parts of the valves were heat-treated—the dome, the body and the wedge. First they were cast in an iron containing about 1 per cent. of nickel and 0.5 per cent. of chromium, and they were finish-machined before heat-treatment. They were oil-hardened and tempered at about 300 deg. C., and the Brinell hardness was 400. The wedge fitted perfectly into the body after heat-treatment, and there were no signs of distortion. Duplicate sets were made, and one set of castings was broken up with a hammer in order to get a rough idea of their strength, and, so far as one could see, the hardened and tempered casting was infinitely stronger after heat-treatment than before. There was no difficulty in machining. The high-nickel iron valve, which was hard as cast, was difficult to machine, the machining occupying about six hours, against half an hour in the other case.

The PRESIDENT asked if Mr. Hurst had tested water-quenching of his specimens, or whether he was afraid of cracking. He suggested this because in research work it was very often desirable to go to extremes at both ends of the line and then to converge towards an equilibrium point. He also asked if Mr. Hurst had analysed every change of relationship of combined and graphitic carbon after hardening in oil. With regard to the effect of drastic annealing, he asked if Mr. Hurst had tried two, or three or more quenchings of the material, in order to ascertain whether ultimately he could restore the condition which existed prior to the apparently destroyed condition of which he had spoken. The elastic constants of the irons were undoubtedly high, and it would have been interesting to have noted the limits of proportionality of the material during the observations. Finally, the President asked what would be the effect of continued heating of the material which had been nitrarded. Did it lose its good qualities in any degree?

AUTHOR'S REPLY.

MR. J. E. HURST, dealing generally with the influence of various elements, said his experience in investigating the possibilities of heat-treating cast iron had yielded what appeared to him to be remarkable results, results which one would not have expected from one's prior training and teaching. That seemed to show that it was very dangerous to attempt to argue by methods of analogy as to the possible influence of any alloying additions to cast iron. What he meant to convey was that it would be quite possible to suggest answers to some of Dr. Everest's questions on the basis of analogy with the influence of these various elements in steels, but he wished to refrain from doing anything of that nature at this stage because he felt that only actual experiment would provide answers to these various points. As this problem of heat-treatment was only just beginning to be investigated, one could quite imagine that there was a vast amount of work remaining to be done. He hoped sincerely that other investigators would take up the question; it was only by extensive investigation that we should ultimately find satisfactory answers to questions dealing with the real influences of nickel, of chromium, of high-total-carbon content, and so on. Frankly, he could not yet give an answer to those questions, based on experiment.

Heat-Treatment Technique.

Commenting on Mr. Lambert's remarks, he said the heat-treatment of any material was accompanied by problems associated with distortion and stresses, and a practical technique had developed in most hardening shops for dealing with the hardening of complicated parts; all sorts of dodges were resorted to in order to obtain successful results. These remarks applied to cast iron, as to other metals. There was a danger of cast iron cracking. Castings had cracked in hardening, just as forgings had cracked in hardening, and one had to use the usual methods of dealing with them; one could rely a good deal on analogy in addition to experiment for guidance in this matter.

Replying to Mr. Lambert's question as to the nature of the tempering operation, he said that in all his work up to date the whole of the tempering was done in salt baths, and the castings were cooled down in ordinary still air after tempering.

Mr. Hurst took the opportunity to express his appreciation of Dr. Everest's remarks. All he wished to say further with regard to the influence of the respective elements was that investigations were in progress having for their object the determination of the influence of some of the elements, particularly nickel and chromium. It would be appreciated that the investigations must be directed primarily with the commercial end in view, and the investigators were dealing first with the elements which were most important from that point of view, such as nickel and chromium. He hoped at some future date, however, to have the opportunity of investigating the effect of elements such as carbon, silicon, manganese, sulphur and phosphorus, all of which must have a vital influence. Very probably, the best composition of cast iron for hardening and tempering, when it was arrived at, would be something totally different from those in use to-day. Dr. Everest had made the suggestion with regard to the experiment on the drastically annealed sample and its hardening which he (Mr. Hurst) had not dared to make. It did appear that the explanation suggested was the only explanation possible, but again he would prefer not to express an opinion on that matter until more extended experimental investigation had been made.

Replying to Mr. Neath, he said that the tensile tests recorded in the Paper were all determined by the ring-test method as laid down in the B.S.I. specification No. 5,004, and the Aircraft Material Specification 4K6. He had not yet had an opportunity to investigate exhaustively the effect of heat-treatment upon the distribution of graphite.

Dealing with Mr. Rowe's question concerning the application of accelerators to the nitrogen-hardening process, he said he had not yet had an opportunity to try out any of the various methods proposed, but hoped to have such an opportunity in the future. In reply to Mr. Russell he said that the aluminium and chromium alloyed cast irons were very difficult to cast. One encountered all the difficulties that were associated with any alloy which contained aluminium. In spite of that, however, he had managed to make satisfactory castings by taking precautions similar to those taken in the casting of other aluminium alloys.

The confirmatory comments by Mr. Hudson on the application of hardening and tempering to valves were very gratifying and he was very glad to know that the results obtained by Mr. Hudson were satisfactory. A valve casting, and particularly a valve body, must be very difficult to deal with from the point of view of quenching.

Replying to the President, he said he had not seriously tested water-quenching yet. Dealing with the question as to whether he had analysed every change in combined carbon and graphite after hardening, he had not seriously investigated that aspect of the hardening problem yet. Neither had he tried more than one quenching. The effect of continued heating of the nitri-cast iron material had been investigated up to a point, as that was of direct commercial interest. Provided the temperature did not exceed 600 deg. C., continued heating applied for long periods of well over 500 hrs., had not made any difference to the hardness Further experiments on this were in progress.

The Iron and Steel Institute.

The following Papers are to be submitted to the joint autumn meeting of the Iron and Steel Institute and the Institute of Metals on behalf of the former body:—

"Equilibrium of the Systems $MnSiO_3$-Fe_2SiO_4 and Fe_2SiO_4," J. H. Andrew and W. R. Maddocks.

"Effect of Hydrogen Sulphide on Corrosion of Iron by Salt Solutions," S. C. Britton, T. P. Hoar and U. R. Evans.

"Endurance Limit of a 0.33 per cent. C Steel at Elevated Temperatures," J. W. Cuthbertson.

"Metallurgical Problems arising from Internal-Combustion Engine Valves," J. R. Handforth.

"Fatigue Resistance of Unmachined Forged Steels," G. A. Hankins and M. L. Becker.

"Time-Potential Curves on Iron and Steel," T. P. Hoar and U. R. Evans.

"A Further Contribution on the Constitution of the Fe-C-Si System," A. Kriz and F. Poboril.

"Light-Weight High-Pressure Gas Cylinders," F. S. Marsh.

"Ni-Cr Si Cast Irons," A. L. Norbury and E. Morgan.

"Veining or Sub-Boundary Structures," L. Northcott.

"Spectroscopic Estimation of Ni, Mn and Cr in Steels," F. Twyman and A. Harvey.

"Generation of Steam from Blast-Furnace Gas," A. F. Webber.

"Growth of Austenite above Ac_1 in Plain-Carbon Steels," J. H. Whiteley.

"Scale Removal by Acid Pickling," A. B. Winterbottom and J. P. Reed.

Catalogue Received.

Glass.—From Pilkington Bros., Limited, of St. Helens, Lancs, we have received a 48-page brochure, which contains two reports on comparative tests made by the National Physical Laboratory and the Building Research Station on "Armourplate" and ordinary plate glass. The former is manufactured by subjecting ordinary polished plate glass to a toughening process which results in a glass of greatly increased mechanical test and more resistant to large and sudden variations in temperature. "Armourplate," when broken, disintegrates into a powder devoid of cutting edges. The new material cannot be cut with a diamond, nor must the surface be drilled; a complete fracture results.

XUM

This Week's News in Brief.

Trade Talk.

THE NEW SUBMARINE "Thames," built by Messrs. Vickers-Armstrongs at Barrow for the British Admiralty, has carried out trials on the Clyde.

AUGUST'S, LIMITED, Thorn Tree Works, Halifax, announce that they have secured the complete contract for supplying the core- and mould-drying plant to Ruston & Hornsby, Limited, Sheaf Iron Works, Lincoln.

IN THE CHANCERY DIVISION, before Mr. Justice Maughan, recently, Sir W. H. Peat was appointed receiver and manager of the Darlington Forge, Limited. The company was represented by counsel, who consented to the appointment being made.

AN INDUSTRIAL DEVELOPMENT EXHIBITION has been held at Bexley, Kent, during the past week. Among the exhibitors were CALLENDER'S CABLE & CONSTRUCTION COMPANY, LIMITED, who were showing cables, joint boxes, insulating tapes and compounds, etc.; the GENERAL ELECTRIC COMPANY, LIMITED, exhibited domestic electrical products, and VICKERS-ARMSTRONGS, LIMITED, showed manufacturing machinery units.

MESSRS. FERGUSON BROS., LIMITED, Port Glasgow, have secured an order from the Rivers Committee of Manchester Corporation for the construction of a new sludge steamer to replace the one which has been in service for 35 years. The new vessel will have a length of 243 ft., a moulded breadth of 38 ft., with a depth moulded of 16½ ft. Delivery is to be effected in eight months.

ON SUNDAY, JULY 17, the L.M.S. railway bridge crossing the Buxton-Bakewell Road near Buxton, was passed over by a train for the last time at 12.35 a.m. By 7.30 a.m. on the same day this bridge had been entirely demolished and a new steel bridge weighing 700 tons rolled into position ready to be crossed by the Sunday trains. The bridge builders were Messrs. Dorman, Long & Company, who for some time have been replacing bridges for the L.M.S. Railway Company.

MESSRS. KITSON & COMPANY, LIMITED, of Airedale Foundry, Leeds, have received an order from the London Midland & Scottish Railway for five saddle-tank locomotives. Since purchasing the business of Messrs. Manning, Wardle & Company in 1927, Messrs. Kitson & Company have done a large trade in small locomotives. They are in possession of all the patterns and drawings taken over from Messrs. Manning, Wardle & Company, and are, therefore, in a position to supply spare parts or undertake repairs of this type of locomotive..

THE KING last week opened the new Lambeth Bridge across the Thames. This steel bridge was built for the London County Council by Messrs. Dorman, Long & Company, Limited. It has five spans totalling 776 ft. in length and is 60 ft. in width, with a roadway 36 ft. wide and two 12-ft. footways. It has been built in place of the old-disused suspension bridge to act as a much-needed additional outlet across the Thames for south-going traffic. Messrs. Dorman, Long & Company, Limited, specially constructed two stands from which their guests could witness the opening ceremony. After the opening, Mr. Charles Mitchell (the chairman), Mrs. Mitchell and the directors of Messrs. Dorman, Long & Company, Limited, entertained their guests on two Thames steamers, which had been specially chartered and which were drawn up alongside the bridge.

G.W.B. ELECTRIC FURNACES, LIMITED, and Wild-Barfield Electric Furnaces, Limited, have entered into a working arrangement with Industrie-Elektroofen G.m.b.H., Cologne, whereby the two former firms will manufacture and sell in Great Britain electric furnaces under the Russ patents. The Russ electric furnaces, which are well known in Germany and France, and for which there is an increasing demand in Great Britain, include induction-type melting furnaces, arc furnaces, ferrous and non-ferrous continuous strip heat-treatment plant, complete with winding gear, etc. The agreement concluded between the three companies, together with that made some time ago with the Hevi Duty Electric Company of Milwaukee, now places G.W.B. Electric Furnaces, Limited, and Wild-Barfield Electric Furnaces, Limited, in a position to manufacture and supply practically every type of electric furnace required for any industrial purpose.

Personal.

MR. ASHTON DAVIES has been appointed Chief Commercial Manager of the L.M.S. Railway.

MR. AND MRS. WILLIAM MCKENZIE, of Motherwell, have celebrated the 50th anniversary of their wedding. Mr. McKenzie has been employed for about 60 years in what is known as the Old Malleable Works, Motherwell.

A PLEASING LITTLE FUNCTION took place in the Counting House of Messrs. Lane & Girvan's Caledonian Foundry, Bonnybridge, on July 21, when Mr. William Whytock was presented with a chiming clock to mark the occasion of his marriage.

MR. J. HAROLD TAYLOR, a former director of Messrs. H. H. Earl & Son, Limited, iron and steel merchants, Sheffield, has been appointed manager of the iron and steel department of Messrs. R. & J. Smith Bros., Limited, Bridge Street, Sheffield.

WILLIAM BAILEY, of Blue Bell Lane, Penrith, who is nearly 88 years of age, has been in the employ of a Penrith firm of ironfounders as a moulder for 75 years, and still goes to the foundry every day, donning his blue jacket. He can see without spectacles.

THE LATE Signor Comm. Ing. Carlo Vanzetti, C.B.E., was posthumously awarded the decoration of "Commander of the Order of the Crown of Belgium" in recognition of his Presidency in 1930 of the International Committee of Foundry Technical Organisations.

MR. AND MRS. ALEXANDER DOWNIE have just celebrated the 50th anniversary of their marriage, which took place on July 14, 1882. Mr. Downie has been for many years in the service of the Ladyacre Engineering Company, Lanark. The firm presented Mr. Downie with a wallet of Treasury notes to mark the occasion.

SIR ERNEST SIMON, Sir Arthur Salter, and Mr. G. Riddle have accepted the invitation of the Prime Minister to serve as members of the Economic Advisory Council. Sir Ernest Simon, who was formerly Liberal M.P. for the Withington division of Manchester, is chairman of Messrs. Henry Simon, Limited, and Simon-Carves, Limited, of Cheadle Heath, Stockport.

MR. JOHN C. INGLIS, of Dumbarton, has just retired after more than 50 years' service with Messrs. William Denny & Bros., Leven Shipyard, Dumbarton. Mr. Inglis, as foreman engineer, has during the half-century seen 1,001 ships built at the Leven yard. He has been a prominent member of the Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen, and was President in 1924 and 1925.

MR. WESLEY LAMBERT, C.B.E., Past-President of the Institute of British Foundrymen, appeared as expert metallurgical witness for the Manganese Bronze & Brass Company, Limited, in the recent action in the King's Bench Division, Messrs. Cammell, Laird & Company, Limited, *versus* the Manganese Bronze & Brass Company, Limited, to recover damages for alleged breach of contract in the supply of a bronze propeller.

Wills.

M'LACHLAN, GEORGE NICOL, ironfounder, Denny £6,607

Obituary.

MR. T. W. RIDLEY, formerly a well-known Middlesbrough engineer, has died at the age of 75. He was associated with the firm of Ridley, Shaw & Company, Limited, North Ormesby, retiring from business in 1925.

MR. J. H. GRIFFITHS, J.P., has died at his home at Old Hill, aged 68. He had been associated with Messrs. N. Hingley & Sons, Limited, of Netherton, Dudley, for over 50 years, rising from the position of office boy to that of commercial manager of the home iron department.

MR. PERCIVAL M. WATTS, of Messrs. Watts, Fincham & Company, Limited, engineers, of Billiter Street, London, E.C.3, died recently. Mr. Watts started in business about 40 years ago as an iron and steel and general merchant, and afterwards became, in addition, a manufacturer and supplier of engineering specialities for the leading shipping companies.

Company Reports.

Warner & Company, Limited.—Interim dividend on the ordinary shares of 6d. per share, less tax.

Mather & Platt, Limited.—Interim dividend of 2½ per cent., actual, less tax, on the ordinary shares.

Gloucester Railway Carriage & Wagon Company, Limited.—Profit, £16,926; brought in, £34,486; carried forward, £51,412.

J. Samuel White & Company, Limited.—Net profit, £433; brought in, £3,047; no dividends are declared; carried forward, £3,480.

Herbert Morris, Limited.—Dividends for the half-year ending July 31 on the 6 per cent. and on the 5 per cent. cumulative preference shares.

Allen West & Company, Limited.—Payment, due on July 31, of the dividend for the half-year in respect of the 7 per cent. cumulative participating preference shares is deferred.

Bradley & Foster, Limited.—Net profit, after providing interest on debentures, £6,875; brought in, £2,002; provision for taxation, £1,121; to depreciation reserve fund, £3,501; investment in Thomas & Isaac Bradley, Limited, written off, £1,068; dividend on the cumulative preferred ordinary shares up to March 31, 1932, at 7½ per cent., £192; dividend on the ordinary shares at 2½ per cent., £937; carried forward, £2,057.

British Electric Transformer Company, Limited.—The accounts for 1931 show a loss of £25,945. In view of the continued fall in prices of raw materials and the accentuated depression of trade, it is considered necessary at this period to write down stocks of materials and manufactured goods by £63,568, including the provision for certain contingent liabilities, bad debts and loss on exchange, bringing the total debit of the profit and loss account to £89,512.

New Companies.

Roebuck Engineering Company, Limited, Oldbury Road, Smethwick.—Capital £2,000. Directors: C. H. and C. W. Pedler.

Engineering Machinery Company, Limited.—Capital, £200. Directors: A. Crawford, 11, Belsham Street, London, E., and C. Baker.

Dick-Cleland, Bennett & Company, Limited.—Capital, £2,000. Engineers. Directors: A. W. A. Dick-Cleland; W. Bennett, Kilmallie, Bishopton.

Burrage & Boyde, Limited.—Capital, £2,000. Engineers. Directors: A. E. Burrage, "The Vale," Towcester Road, Northampton, and W. A. C. Boyde.

James & Williams (Battersea), Limited, 31, Queen's Road, Battersea, London, S.W.—Capital, £2,000. Engineers. Directors: J. Callaghan and W. F. Pope.

Clyde Aluminium Piston Company, Limited, Victoria Works, 376, Townmill Road, Glasgow, E.—Capital, £500. Directors: G. S. Anderson, A. Campbell and D. G. H. Edward.

Imported Wood Screws.

The Import Duties Advisory Committee gives notice of an application for increased duties by Messrs. Guest, Keen & Nettlefolds, Limited, the British Screw Company, Limited, and Messrs. Henry Cox Screw Company, Limited, in respect of wood screws of iron or steel or non-ferrous metal. The Committee has also received an application for the addition of magnesium metal and magnesium alloys to the free list. Any representations which interested parties desire to make in regard to these articles should be addressed in writing to the Secretary, Import Duties Advisory Committee, Caxton House (West Block), Tothill Street, London, S.W.1.

Government Interest in German Iron and Steel Industry.

The German Government, by a purchase of shares, has obtained control of the United Steelworks Corporation, which produces 40 per cent. of the total German iron and steel output. It has obtained this control by the purchase of 51 per cent. of the shares of the Gelsenkirchen Mining Company, which owns a large proportion of the capital of the United Steelworks Corporation (Vereinigte Stahlwerke, A.G.).

B.A. Co. Aluminium is produced in two standard forms. (1) Virgin aluminium, 98/99% and higher purities, in notched bars. (2) Alloys, ready mixed to B.A. Co., British Standard and special specifications, in ingots. The marketing of these two standard forms is backed by the B.A. Co. research organisation and manufacturing experience.

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CAST IRON FLANGED PIPES
2 in.—12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
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BRANDS "DALZELL", "GLENGARNOCK", "CLYDE" & "MONKLAND"
HIGH GRADE HEMATITE PIG IRON
SPECIAL & ORDINARY FOUNDRY QUALITIES & FORGE
SPECIAL REFINED WITH TOTAL CARBON
GUARANTEED NOT EXCEEDING 3·0% MAX.
COLVILLES LTD
GLASGOW

Raw Material Markets.

At the moment, the slow conditions in the iron and steel markets are being accentuated by the seasonal inactivity. Consumers show little inclination to buy, but optimism is already being expressed regarding the prospects for the autumn, by which time a large proportion of the stocks now held at consuming works should need replacement. Pig-iron production is being further restricted in Scotland, while two hematite furnaces have been put out in Cleveland, although there are prospects of another two being blown in. Owing to the continued depression in the shipbuilding and heavy engineering industries, there is little demand for finished steel material.

Pig-Iron.

MIDDLESBROUGH.—Sales of pig-iron remain very limited, and it is believed that part of the weekly output is having to be stocked by the makers. This is largely due to the seasonal slackness in Scotland and to the very poor export market. The local ironfounders are also not very active. Quotations are unchanged at:—No. 1 Cleveland foundry iron, 61s.; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton, f.o.t. or f.o.b.

Orders are scarce in the East Coast hematite market and competition remains keen. Two hematite furnaces have been put out at Normanby Ironworks, the makers having accumulated large stocks. There are, however, prospects of two others being blown in at the Avresome Ironworks. Mixed numbers have now been reduced from 62s. to about 61s. per ton, with even lower quotations for large quantities. There are reports of Dutch hematite being offered at 62s. 6d. per ton f.o.t. Grangemouth. The current demand for West Coast hematite is not very good but it is thought that business will show considerable improvement during the autumn. Bessemer mixed numbers remain at 66s. per ton at works.

LANCASHIRE.—New orders for foundry iron are scarce, but an irregular demand from various quarters accounts for a fairly steady total consumption. The light-castings industries are fairly well employed, but the output of the jobbing foundries remains at a low level. Prices are steady at 67s. per ton for Derbyshire, Staffordshire and North-East Coast iron, 65s. 6d. for Northants, 62s. for Derbyshire forge, around 84s. 6d. for Scottish foundry, and 81s. for West Coast hematite, for delivery Manchester or equal distance. Offers of Indian pig-iron for delivery in the Manchester district are reported at from about 67s. to 77s. per ton.

MIDLANDS.—This district is also feeling the effect of the seasonal quietude, and deliveries of pig are much restricted. Apart from those engaged on light-castings or electrical work, the foundries are having a very difficult time, and the prospects for pig-iron consumption are not very good at the moment. Prices are unchanged, local quotations being as follow, delivered Birmingham and Black Country stations:—Northants foundry, No. 3, 62s. 6d.; No. 1, 65s. 6d.; forge, 57s. 6d.; Derbyshire, No. 3, 66s.; No. 1 foundry, 69s.; forge, 61s. per ton. Lincolnshire and North Staffordshire brands of pig are obtainable at the same price as Derbyshire. Cleveland No. 3 pig-iron is offered at the competitive price of 66s. per ton, delivered Midland stations.

SCOTLAND.—Business remains practically at a standstill in the Glasgow area. Prices are unaltered. No. 3 foundry is at 69s. 6d. per ton at furnaces, with 2s. 6d. per ton extra for No. 1. The demand for No. 1 is negligible. Middlesbrough iron continues on offer at 55s. 6d. per ton for No. 3 f.o.t. Falkirk. Other English irons can be obtained at slightly less.

Coke.

The demand for coke is very limited, in accordance with conditions in the consuming industries. More and more ovens are now making concessions in the prices of the higher grades. Best Durham coke, delivered Birmingham and district, is at 37s. 6d., with other grades at 35s. Welsh foundry coke varies from 30s. to 45s., also delivered Birmingham, according to analysis and tonnage.

Steel.

The finished-steel market is largely inactive, both in the light and heavy sections. The latter, particularly, continues to suffer from the depression in the shipbuilding and structural-engineering trades. As a result of the strike in Belgium, prices of foreign material have advanced somewhat. The foreign prices for small bars are £4 18s. to £5 0s. 6d., according to specification, delivered South Staffordshire, while the British rollers quote £6 7s. 6d. to £7 per ton. In view of the seasonal quietness, there is little call for semi-finished steel. Prices of Continental semis were also advanced as a result of the strike in Belgium, placing the British works in a slightly better position. The business available, however, is very limited.

Scrap.

In the Cleveland scrap-iron market there is little response to offers of ordinary heavy cast iron at 35s. and good machinery quality at 36s. Light castings are available at 30s. Heavy supplies of scrap are also on offer in the Midlands, heavy cast-iron machinery scrap in handy pieces being at 45s. delivered, good heavy metal at 40s. delivered and clean light metal at 35s. 6d. to 36s. 6d. delivered. There is a slightly better inquiry in South Wales for heavy cast iron, in large pieces and furnace sizes, which can be obtained at 38s. to 40s. Good cast-iron machinery scrap in cupola sizes has a limited demand at 42s. 6d. to 45s. In Scotland, prices are largely nominal, all deliveries of scrap being suspended.

Metals.

Copper.—The standard quotation on the London market has now fallen to below £25—a new low record. The setback was mainly due to continued selling by various holders who had been disappointed by the June world production and consumption statistics, of which unfavourable reports have been recently received. The trade demand remains poor in this country, the rate of consumption having shown no recovery from its recent low levels. In the United States also the market demand continues very irregular. Much depends on the Ottawa Conference, as the Canadian copper producers, in particular, having lost their United States outlet, are particularly anxious for a protected market inside the Empire. This would probably lead to an association of Empire producers and the establishment of a more economic market.

Closing quotations :—

Cash.—Thursday, £25 5s. to £25 7s. 6d.; Friday, £25 7s. 6d. to £25 10s.; Monday, £25 to £25 1s. 3d.; Tuesday, £25 to £25 2s. 6d.; Wednesday, £25 2s. 6d. to £25 3s. 9d.

Three Months.—Thursday, £24 17s. 6d. to £24 18s. 9d.; Friday, £25 1s. 3d. to £25 3s. 9d.; Monday, £24 10s. to £24 12s. 6d.; Tuesday, £24 11s. 3d. to £24 12s. 6d.; Wednesday, £24 15s. to £24 16s. 3d.

Tin.—The tin market has been very dull during the past week, lack of interest from consumers being chiefly responsible for an early decline in prices. Some buying has been seen on the Continent, but of an irregular character. European consumption generally shows little sign of recovery.

Official closing prices :—

Cash.—Thursday, £125 10s. to £125 12s. 6d.; Friday, £124 15s. to £125; Monday, £124 5s. to £124 10s.; Tuesday, £125 12s. 6d. to £125 15s.; Wednesday, £127 to £127 5s.

Three Months.—Thursday, £127 7s. 6d. to £127 10s.; Friday, £126 15s. to £127; Monday, £126 to £126 5s.; Tuesday, £127 5s. to £127 10s.; Wednesday, £128 10s. to £128 15s.

Spelter.—A small but steady trade is being done with consumers and the general undertone is fairly confident. The 6,000-ton reduction which took place in the Cartel's stocks during June should be at least repeated during this month, at the end of which a further cut in output is to come into operation. It is this firm control of supplies, without any interference with price fluctuations, that is the strength of this market.

Daily fluctuations :—

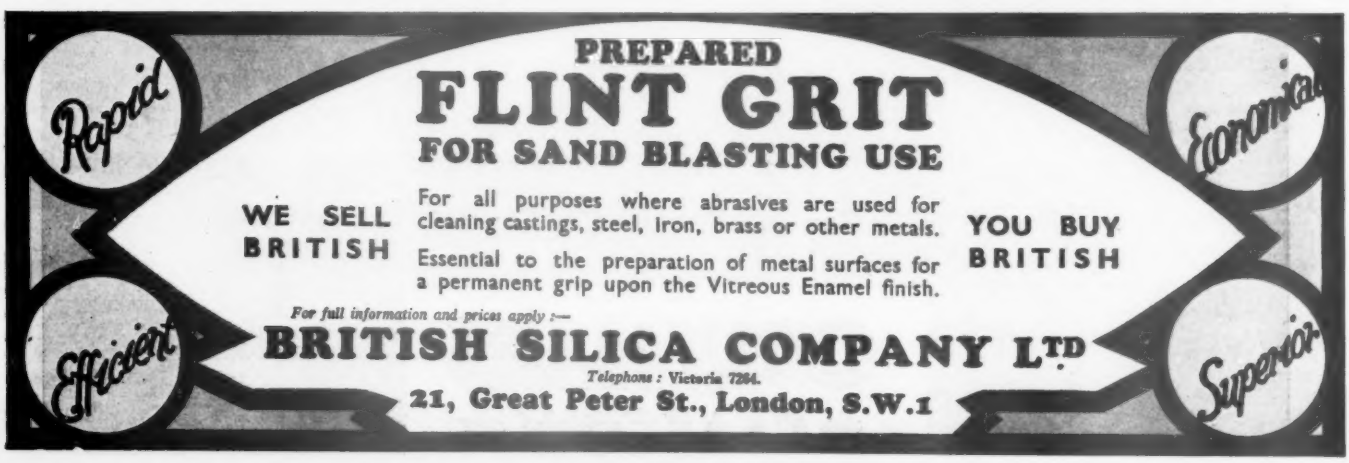
Ordinary.—Thursday, £11 11s. 3d.; Friday, £11 11s. 3d.; Monday, £11 12s. 6d.; Tuesday, £11 15s.; Wednesday, £11 17s. 6d.

Lead.—Owing to the continued consuming depression on the Continent, several forced sales have been made on the London market, the weakening effect of which has been increased by the general low level of consumption. The future of the market will depend largely upon industry's recovery from the present depression, as little can be done with consumption at its present level.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £9 11s. 3d.; Friday, £9 12s. 6d.; Monday, £9 12s. 6d.; Tuesday, £9 12s. 6d.; Wednesday, £9 13s. 9d.

THE FOUNDATION STONES of a new bridge across the Tees at Middlesbrough were laid on Thursday, July 14. The bridge is being constructed by Messrs. Dorman, Long & Company, Limited.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Economical
PREPARED
FLINT GRIT
FOR SAND BLASTING USE
WE SELL BRITISH
For all purposes where abrasives are used for cleaning castings, steel, iron, brass or other metals.
Essential to the preparation of metal surfaces for a permanent grip upon the Vitreous Enamel finish.
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Efficient
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TRADE SIROCCO MARK

EQUIPMENTS

For removal of Dust, Steam or Fumes + Ventilation of Buildings, Mines & Ships + Mechanical Boiler Draught + Cooling & Drying + Air Conditioning + Pneumatic Conveying.

Sirocco Centrifugal, Dust & High Pressure Fans.

DUST COLLECTORS for Chimney Gases and general Industrial purposes.

AIR WASHERS + AIR HEATERS (Steam or Direct Fired) Steam Turbine Heater Units.

DAVIDSON & CO., LIMITED.
Sirocco Engineering Works, Belfast.

LONDON, MANCHESTER, BIRMINGHAM, NEWCASTLE, CARDIFF, BRISTOL, GLASGOW.

FOR REFINED PIG OF THE HIGHEST QUALITY
CONSIDER THE APPLICATIONS OF THE SODA ASH PROCESS
It produces

PIG IRON for grey iron castings which are tough, easy to machine, close grained and of consistent quality.
WHITE and MOTTLED PIG for malleable castings, having a shorter annealing time and improved physical properties.
REFINED ALLOY PIG with better yields on the alloying elements.

The Soda Ash process is economical and easy to apply.

It enables the manufacturer to control the sulphur content of the metal within close limits and to reduce it by 45-80%. It removes gaseous and non-metallic inclusions, and refines the graphite.

It permits of the use of the lowest grade scrap and high sulphur coke.

Full details and information will be supplied by

IMPERIAL CHEMICAL INDUSTRIES LTD.
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Sales Offices: Belfast, Birmingham, Bradford, Bristol, Dublin, Glasgow, Leicester, Liverpool, London, Manchester, Newcastle-on-Tyne

ICI

C.N. 21

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	25 2 6
Three months	24 15 0
Electrolytic	27 10 0
Tough	26 0 0
Best selected	26 10 0
Sheets	57 0 0
India	37 0 0
Wire bars	29 0 0
Do., Sept.	28 10 0
Do., Oct.	28 0 0
Ingot bars	29 15 0
H.C. wire rods	32 10 0
Off. av. cash, June	26 18 4 5/8
Do., 3 mths., June	26 14 8 1/4
Do., Sttlmnt., June	26 18 7 7/32
Do., Electro, June	31 5 2 3/4
Do., B.S., June	30 4 4 1/2
Do., wire bars, June	31 13 7 7/32
Solid drawn tubes	9 1/2d.
Brazed tubes	9 1/2d.
Wire	6 1/4d.

BRASS.

Solid drawn tubes	8 1/2d.
Brazed tubes	10 1/2d.
Rods, drawn	7 1/2d.
Rods, extd. or rlld.	4 1/2d.
Sheets to 10 w.g.	7 1/2d.
Wire	7 1/2d.
Rolled metal	6 1/2d.
Yellow metal rods	4d.
Do. 4 × 4 Squares	5 1/2d.
Do. 4 × 3 Sheets	5 1/2d.

TIN.

	£ s. d.
Standard cash	127 0 0
Three months	128 10 0
English	128 10 0
Bars	129 10 0
Straits	130 12 6
Australian	128 12 6
Eastern	132 0 0
Banca	135 12 6
Off. av. cash, June	114 12 11
Do., 3 mths., June	116 18 5 3/4
Do., Sttlmt., June	114 13 1 1/2

SPELTER.

	£ s. d.
Ordinary	11 17 6
Remelted	11 0 0
Hard	9 10 0
Electro 99.9	14 2 6
English	12 12 6
India	11 0 0
Zinc dust	19 0 0
Zinc ashes	1 15 0
Off. aver., June	11 14 1 17/32
Aver. spot, June	11 10 11 13/16

LEAD.

	£ s. d.
Soft foreign ppt.	9 13 9
Empire	10 5 0
English	11 10 0
Off. average, June	9 15 0 1/4
Average spot, June	9 12 1 10/32

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	22 10 0
Do., V.M. ex-whf.	20 10 0
Rods	26 0 0
Boiler plates	—
Battery plates	—

ANTIMONY.

	£ s. d.
English	35 0 0 to 42 10 0
Chinese	22 0 0
Crude	16 0 0

QUICKSILVER.

	£ s. d.
Quicksilver	9 10 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	8 5 0
45/50%	13 5 0
75%	19 0 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	11d. lb.
Ferro-phosphorus, 20/25%	£21 0 0
Ferro-tungsten—	
80/85%	1/9 lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car.	£34 10 0
4/6% car.	£25 0 0
6/8% car.	£24 10 0
8/10% car.	£23 15 0
Ferro-chrome—	
Max. 2% car.	£37 0 0
Max. 1% car.	£46 17 6
Max. 0·70% car.	£48 5 0
70% carbon-free	1/1 lb.
Nickel—80/99.5%	£230 to £235
"F" nickel shot	£207 0 0
Ferro-cobalt	8/- lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 0 0
Metallic manganese—	
94/96% carbon-free	1/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 5/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.	£ s. d.
South Wales—		
Heavy steel	1 17 6	to 1 18 6
Bundled steel and shrngs.	1 14 0	to 1 17 0
Mixed iron and steel	1 15 0	
Heavy cast iron	1 18 0	to 2 0 0
Good machinery	2 2 6	to 2 5 0
Cleveland—		
Heavy steel	1 15 0	
Steel turnings	1 10 0	
Cast-iron borings	1 2 6	
Heavy forge	2 10 0	
W.I. piling scrap	2 2 6	
Cast-iron scrap	1 15 0	to 1 16 0
Midlands—		
Light cast-iron scrap	1 16 0	
Heavy wrought iron	2 5 0	
Steel turnings, f.o.r.	0 18 0	
Scotland—		
Heavy steel	1 15 0	
Ordinary cast iron	2 0 0	
Engineers' turnings	1 8 0	
Cast-iron borings	1 10 0	
Wrought-iron piling	1 18 0	
Heavy machinery	2 4 0	

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	21 0 0
Brass	12 0 0
Lead (less usual draft)	7 0 0
Tea lead	5 0 0
Zinc	5 5 0
New aluminium cuttings	72 0 0
Brassery copper	17 0 0
Gunmetal	16 0 0
Hollow pewter	70 0 0
Shaped black pewter	50 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	61/6
Hematite M/Nos.	61/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/-
d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
No. 4 forge*	61/-
No. 3 fdry.*	66/-
Shrops basic	—
Cold blast, ord.	—
roll iron	—
Northants forge*	57/6
fdry. No. 3*	62/6
fdry. No. 1*	65/6
Derbyshire forge*	61/-
fdry. No. 3*	66/-
fdry. No. 1*	69/-
basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
fdry. No. 3	63/6
Lincs forge	—
fdry. No. 3	63/6
E.C. hematite	74/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	84/6
Clyde, No. 3	84/6
Monkland, No. 3	84/6
Summerlee, No. 3	84/6
Eglinton, No. 3	84/6
Gartsherrie, No. 3	84/6
Shotts, No. 3	84/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	9 5 0	to 9 15 0
Nut and bolt iron	7 15 0	to 8 10 0
Hoops	10 10 0	to 12 0 0
Marked bars (Staffs) f.o.t.	12 0 0	
Gas strip	10 10 0	to 12 0 0
Bolts and nuts, ¾ in. × 4 in.	12 0 0	
Steel—		
Plates, ship, etc.	8 15 0	to 8 17 6
Boiler plts.	8 7 6	to 9 5 0
Chequer plts.	10 7 6	
Angles	8 7 6	
Tees	9 7 6	
Joists	8 15 0	
Rounds and squares, 3 in. to 5½ in.	9 7 6	
Rounds under 3 in. to ¾ in. (Untested)	6 12 6	& up.
Flats—8 in. wide and over	8 12 6	
under 8 in. and over 5 in.	8 17 6	
Rails, heavy	8 5 0	to 8 10 0
Fishplates	12 0 0	
Hoops (Staffs)	9 10 0	
Black sheets, 24g.	8 0 0	to 8 10 0
Galv. cor. shts.	9 5 0	to 9 15 0
Galv. flat shts.	9 15 0	to 10 15 0
Galv. fencing wire, 8g. plain	12 7 6	
Billets, soft	4 17 6	to 5 7 6
Billets, hard	6 12 6	
Sheet bars	4 15 0	to 5 5 0
Tin bars	4 15 0	

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10d.
Sheet to 10 w.g.	11d.
Wire	11½d.
Rods	10d.
Tubes	15½d.
Castings	12d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated

	Dols.
No. 2 foundry, Phila.	14.34
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.39
Bessemer	16.89
Malleable	16.39
Grey forge	16.39
Ferro-mang. 80%, seaboard	68.00
O.-h. rails, h'y, at mill	43.00
Billets	26.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.60
Sheets, black, No. 24	2.20
Sheets, galv., No. 24	2.85
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 22/6
furnace	16/- to 16/6
Durham and Northumberland—	
foundry	21/- to 25/-
furnace	13/- to 13/6
Midlands, foundry	—
furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	15/- to 15/6
	28×20 "	30/- to 31/-
	20×10 "	22/- to 22/3
	18¾×14 "	15/6 to 15/9
C.W.	20×14 "	13/3
	28×20 "	—
	20×10 "	—
	18¾×14 "	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars, hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£ s. d.	
July	21 ..	25 5 0	dec. 2/6
,,	22 ..	25 7 6	inc. 2/6
,,	25 ..	25 0 0	dec. 7/6
,,	26 ..	25 0 0	No change
,,	27 ..	25 2 6	inc. 2/6

Electrolytic Copper.

		£ s. d.	
July	21 ..	27 10 0	dec. 5/-
,,	22 ..	27 10 0	No change
,,	25 ..	27 10 0	,, ,,
,,	26 ..	27 10 0	,, ,,
,,	27 ..	27 10 0	,, ,,

Standard Tin (cash).

		£ s. d.	
July	21 ..	125 10 0	inc. 40/-
,,	22 ..	124 15 0	dec. 15/-
,,	25 ..	124 5 0	,, 10/-
,,	26 ..	125 12 6	inc. 27/6
,,	27 ..	127 0 0	,, 27/6

Tin (English ingots).

		£ s. d.	
July	21 ..	127 5 0	inc. 35/-
,,	22 ..	126 15 0	dec. 10/-
,,	25 ..	126 0 0	,, 15/-
,,	26 ..	127 10 0	inc. 30/-
,,	27 ..	128 10 0	,, 20/-

Spelter (ordinary).

		£ s. d.	
July	21 ..	11 11 3	inc. 2/6
,,	22 ..	11 11 3	No change
,,	25 ..	11 12 6	inc. 1/3
,,	26 ..	11 15 0	,, 2/6
,,	27 ..	11 17 6	,, 2/6

Spelter (Electro, 99.9 per cent.).

		£ s. d.	
July	21 ..	14 5 0	inc. 5/-
,,	22 ..	14 0 0	dec. 5/-
,,	25 ..	14 0 0	No change
,,	26 ..	14 2 6	inc. 2/6
,,	27 ..	14 2 6	No change

Zinc Sheets (English).

		£ s. d.	
July	21 ..	22 10 0	No change
,,	22 ..	22 10 0	,, ,,
,,	25 ..	22 10 0	,, ,,
,,	26 ..	22 10 0	,, ,,
,,	27 ..	22 10 0	,, ,,

Lead (English).

		£ s. d.	
July	21 ..	11 10 0	inc. 5/-
,,	22 ..	11 10 0	No change
,,	25 ..	11 10 0	,, ,,
,,	26 ..	11 10 0	,, ,,
,,	27 ..	11 10 0	,, ,,

AVERAGE MONTHLY PRICES OF STEEL SHIP PLATES (NORTH OF ENGLAND).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	5 0 0	5 0 0	5 2 6	5 2 6	5 2 6	5 0 0	5 0 0	5 0 0	5 0 0	5 2 6	5 10 0	5 10 0	5 2 6
1897	5 10 0	5 10 0	5 10 0	5 7 6	5 2 6	5 2 6	5 0 0	5 0 0	5 0 0	5 0 0	5 7 6	5 10 0	5 5 5
1898	5 10 0	5 8 9	5 8 9	5 10 0	5 16 3	5 18 9	5 17 6	6 0 0	6 2 6	6 5 0	6 10 0	6 15 0	5 18 6½
1899	6 15 0	7 0 0	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 12 6	7 12 6	7 12 6	7 12 6	8 0 0	7 6 5½
1900	8 0 0	8 0 0	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 0 0	8 0 0	8 0 0	7 10 0	7 0 0	8 0 0
1901	6 15 0	6 15 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 5 0	6 7 6	6 5 0	6 0 0	6 0 0	6 4 4
1902	5 17 6	5 12 6	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 10 0	5 14 7½
1903	5 10 0	5 10 0	5 15 0	6 0 0	6 0 0	6 0 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 10 0	5 13 11
1904	5 7 6	5 10 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 11 10
1905	5 15 0	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	6 0 0	6 10 0	7 0 0	7 0 0	6 2 3½
1906	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 10 0	7 0 10½
1907	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 8 4
1908	6 10 0	6 10 0	6 10 0	6 5 0	6 5 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 3 9
1909	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	5 15 0	5 15 0	5 15 0	6 0 0	6 0 0	6 0 0	6 0 0	5 18 9
1910	6 5 0	6 5 0	6 7 6	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 2
1911	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 18 4	6 15 3½
1912	7 3 9	7 5 6	7 5 0	7 12 6	7 15 0	7 15 0	7 15 0	8 0 0	8 0 0	8 0 0	8 2 0	8 5 0	7 14 10
1913	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	7 19 0	7 15 0	7 3 0	6 15 0	6 10 0	7 16 5½
1914	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 0 0	6 0 0	7 0 0	7 5 0	7 5 0	7 6 3	7 10 0	6 14 8½
1915	8 0 0	8 10 0	9 0 0	9 10 0	9 10 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 5 0	11 0 0	9 12 11
1916	11 7 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 9 2
1917	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1918	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1919	11 10 0	14 0 0	14 0 0	17 0 0	17 0 0	17 7 6	17 15 0	18 5 0	18 5 0	18 5 0	19 12 6	21 5 0	16 15 5
1920	22 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	24 0 0	24 10 0	24 5 0	24 5 0	23 13 4
1921	23 5 0	22 10 0	20 4 0	19 0 0	19 0 0	17 0 0	15 0 0	14 15 0	13 12 0	12 5 0	10 10 0	10 10 0	16 9 3
1922	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 4 0	10 0 0	9 7 6	9 4 0	9 5 0	9 5 0	9 5 0	9 18 4½
1923	9 7 6	9 15 0	10 5 0	10 10 0	10 10 0	10 10 0	9 18 9	9 17 6	9 17 6	9 17 6	9 18 6	10 6 10½	10 1 2½
1924	10 1 6	9 18 1½	9 17 6	9 17 6	9 17 6	9 19 4½	10 5 0	10 5 0	10 5 0	9 19 0	9 15 0	9 15 0	9 19 7½
1925	9 14 0	9 10 0	9 1 3	9 0 0	9 0 0	8 17 0	8 13 1½	8 7 6	8 4 0	8 5 6	7 16 3	7 14 3	8 15 8½
1926	7 12 2½	7 12 6	7 12 6	7 14 4½	7 15 0	7 16 10½	8 2 6	8 2 6	8 4 0	8 12 6	8 12 6	8 16 3	8 1 1½
1927	8 17 6	8 17 6	8 11 6	8 7 6	8 6 3	8 5 0	8 5 0	8 3 9	8 2 6	8 2 6	8 5 0	8 5 0	8 7 5
1928	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 6 10½
1929	8 7 6	8 7 6	8 7 6	8 7 6	8 10 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 13 9	8 10 9½
1930	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1931	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1932	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	—	—	—	—	—	—

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